INITIAL STUDY
DRAFT NEGATIVE DECLARATION

On-going California State Water Project Operations in the Sacramento-San Joaquin Delta for the Protection of Longfin Smelt

January 2009

State of California
DEPARTMENT OF WATER RESOURCES

Notice of Intent to Adopt a
Negative Declaration

DATE: **January 13, 2009**

TO: **Interested Parties**

FROM: **California Department of Water Resources**

Re: **A Negative Declaration for the On-going California State Water Project Operations in the Sacramento-San Joaquin Delta for the Protection of Longfin Smelt is available for public review beginning January 13, 2009.**

Project Location and Description: The proposed project, or action, is the Department of Water Resources' (DWR) on-going and long-term operation of the State Water Project (SWP) in the manner consistent with the protection and conservation of the longfin smelt (*Spirincus thaleichthys*) in compliance with the California Endangered Species Act (CESA) as authorized by the California Department of Fish and Game (DFG) through issuance of a permit for take of longfin smelt under Section 2081 of CESA (California Fish and Game Code Section 2081). The action consists of operation of SWP facilities consistent with certain actions identified in the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion of the Operating Criteria and Plan for the Coordinated Operations of the Central Valley Project and State Water Project (USFWS 2008). The action includes operation of SWP facilities from December through June to protect adult longfin smelt migration and spawning and larvae and juvenile rearing. The protection of longfin smelt is achieved through operations undertaken during the same period to protect delta smelt which are sufficient for the protection of longfin smelt because of adaptive management provisions and the substantial overlap in timing and distribution of these species in the Sacramento-San Joaquin Delta. The specific operations are described in detail in Chapter 2, Project Description (see section titled Proposed State Water Project Operations for Protection of Longfin Smelt) in the attached Initial Study (IS). Additional monitoring measures are described in Section 2.7 of the IS, Minimization Measures for SWP Operations.

Document Review and Availability: The public comment period will extend from **January 13, 2009 through February 2, 2009**. The Negative Declaration is available for public review at the following locations:

- Sacramento Public Library, 828 I Street, Sacramento, CA 95814
- Stockton-San Joaquin County Public Library - Cesar Chavez Central Library, 605 N. El Dorado Street, Stockton, CA 95202

Contact: Comments on the Initial Study/Draft Negative Declaration can be directed to:

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DRAFT NEGATIVE DECLARATION

PROJECT TITLE	**ON-GOING CALIFORNIA STATE WATER PROJECT OPERATIONS IN THE SACRAMENTO-SAN JOAQUIN DELTA FOR THE PROTECTION OF LONGFIN SMELT**
DATE:	January 13, 2009
LEAD AGENCY:	California Department of Water Resources
CONTACT PERSON:	Heidi Rooks, Chief of Ecological Studies Branch, Division of Environmental Services

PROJECT DESCRIPTION

The proposed project, or action, is the Department of Water Resources' (DWR) on-going and long-term operation of the State Water Project (SWP) in the manner consistent with the protection and conservation of the longfin smelt (*Spirincus thaleichthys*) in compliance with the California Endangered Species Act (CESA) as authorized by the California Department of Fish and Game (DFG) through issuance of a permit for take of longfin smelt under Section 2081 of CESA (California Fish and Game Code Section 2081). The action consists of operation of SWP facilities consistent with certain actions identified in the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion of the Operating Criteria and Plan for the Coordinated Operations of the Central Valley Project and State Water Project (USFWS 2008). The action includes operation of SWP facilities from December through June to protect adult longfin smelt migration and spawning and larvae and juvenile rearing. The protection of longfin smelt is achieved through operations undertaken during the same period to protect delta smelt which are sufficient for the protection of longfin smelt because of adaptive management provisions and the substantial overlap in timing and distribution of these species in the Sacramento-San Joaquin Delta. The specific operations are described in detail in Chapter 2, Project Description (see section titled Proposed State Water Project Operations for Protection of Longfin Smelt) in the attached Initial Study (IS). Additional monitoring measures are described in Section 2.7 of the IS, Minimization Measures for SWP Operations.

DECLARATION

The California Department of Water Resources has determined that the above project would have no significant impact on the environment and an EIR will not be prepared. The determination is based on the attached Initial Study and the following findings:

1. The project will not degrade environmental quality, substantially reduce habitat, cause a wildlife population to drop below self-sustaining levels, reduce the number or restrict the range of special-status species, or eliminate important examples of California history or prehistory.

2. The project does not have the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.

3. The project will not have impacts that are individually limited but cumulatively considerable.

4. The project will not have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly.

5. No substantial evidence exists that the project will have a negative or adverse effect on the environment.

6. The project incorporates all applicable mitigation measures or environmental commitments identified in the Initial Study (attached).

7. This Negative Declaration reflects the independent judgment of the lead agency.

PUBLIC REVIEW

Written comments on the Initial Study and Draft Negative Declaration should be submitted no later than 5:00 p.m. February 2, 2009 to:

Ms. Heidi Rooks
California Department of Water Resources
PO Box 942836
Sacramento, CA 94236
ATTN: Longfin Smelt Initial Study/Draft Negative Declaration

Comments also may be submitted by email (hrooks@water.ca.gov) or fax (916/376-9688).

Initial Study
On-going California State Water Project Operations in the Sacramento-San Joaquin Delta for the Protection of Longfin Smelt

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List of Acronyms

AF...acre-feet
Banks Pumping Pump................Harvey O. Banks Pumping Plant
CA ....California Aqueduct
CARB ....California Air Resources Control Board
CCF ....Clifton Court Forebay
CCR...California Code of Regulations
CESA...California Endangered Species Act
cfs..cubic feet per second
Commission ....California Fish and Game Commission
Corps..U.S. Army Corps of Engineers
CVP ....Central Valley Project
CVPIA..Central Valley Project Improvement Act
DAT ....Data Assessment Team
Delta ....Sacramento-San Joaquin Delta
DFG...California Department of Fish and Game
DWR..California Department of Water Resources
E/I ....Export/Inflow (ratio)
EIR ....Environmental Impact Report

EIS/EIR	Environmental Impact Statement/Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ERP	Ecosystem Restoration Program
ESA	Federal Endangered Species Act
EWA	Environmental Water Account
FGC	Fish and Game Code
FMWT	Fall Midwater Trawl Survey
ft/s	feet per second
GORT	Gate Operations Review Team
HORB	Head of Old River Barrier
IEP	Interagency Ecological Program
IS	Initial Study
Jones	Jones Pumping Plant
JPOD	Joint Point of Diversion
M&I	municipal and industrial
MWDSC	Metropolitan Water District of Southern California
MIDS	Morrow Island Distribution System
msl	mean sea level
NBA	North Bay Aqueduct
NEPA	National Environmental Policy Act
NTU	Nephelometric Turbidity Units
OMR	Old Middle and Middle Rivers
POD	Pelagic Organism Decline
QSA	Quantification Settlement Agreement
QWEST	net flow of the San Joaquin River near the confluence with the Sacramento River)
Reclamation	Bureau of Reclamation
ROD	Record of Decision
RPA	Reasonable Prudent Alternative
RRDS	Roaring River Distribution System
Skinner Fish Facility	John E. Skinner Delta Fish Protective Facility
SKT	Spring Kodiak Trawl Survey
SMPA	Suisun Marsh Preservation Agreement
SMSCG	Suisun Marsh Salinity Control Gates
SRCD	Suisun Resource Conservation District
Suisun Marsh Plan	Habitat Management, Preservation, and Restoration Plan for the Suisun Marsh
SWG	Smelt Working Group
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TBP	South Delta Temporary Barrier Project
TNS	Summer Townet Survey
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAMP	Vernalis Adaptive Management Program
WOMT	Water Operations Management Team
WQCP	Water Quality Control Plan
X2	(the distance in kilometers up the axis of the Estuary to where the tidally averaged near-bottom salinity is 2 practical salinity units)

CHAPTER 1
INTRODUCTION

This Initial Study (IS) has been prepared to comply with the California Environmental Quality Act (CEQA) and to analyze whether there would be potential environmental impacts associated with actions taken by the Department of Water Resources (DWR) in operating the California State Water Project (SWP) for the protection of longfin smelt. This document has been prepared in accordance with CEQA, Public Resources Code §21000 *et seq*., and the State CEQA Guidelines, California Code of Regulations (CCR) §15000 *et seq*. Appendix 1 provides a map of the project area and SWP facilities.

1.2 BACKGROUND

In 2007, The Bay Institute, Center for Biological Diversity, and Natural Resources Defense Council petitioned to have the Bay-Delta longfin smelt populations listed as threatened species under both the California Endangered Species Act (CESA) and Federal Endangered Species Act (ESA) (The Bay Institute et al. 2007a and 2007b). In December 2007, the California Department of Fish and Game (DFG) completed a preliminary review of the longfin smelt petition (DFG 2007 *as cited in* SAIC 2008) and concluded that there was sufficient information to warrant further consideration by the California Fish and Game Commission (Commission). On February 7, 2008 the Commission designated the longfin smelt as a candidate for potential listed under the CESA. Candidate species are provided protection under CESA and actions that may jeopardize the continued existence of the species require take authorization.

On February 20, 2008, the Commission issued an emergency regulation pursuant to Fish and Game Code section 2084 authorizing take of longfin smelt by the SWP and also imposing restrictions on the SWP under certain conditions for the purpose of protecting longfin smelt (Cal. Code Regs. Title 14, § 749.3). The emergency regulation requires DWR to modify the operations of the SWP to meet prescribed flow ranges in Old and Middle Rivers that are designed to protect larval and juvenile longfin smelt. The emergency regulation was initially effective until August 27, 2008, was extended to November 2008, and expires on February 23, 2009.

1.3 PROJECT OBJECTIVES

At the March 5 or 6, 2009, Commission meeting, the Commission will determine whether to list longfin smelt as an endangered or threatened species pursuant to CESA. If the Commission does list the longfin smelt, DWR will need an incidental take permit for its on-going operations of the SWP. Therefore, in anticipation of the possible listing of longfin smelt under CESA, DWR has applied to DFG pursuant to Fish and Game Code section 2081 for an Incidental Take Permit for longfin smelt for continued operations of the SWP.

In addition, DWR will need a short-term take permit for longfin smelt as a candidate species during the two-week period after expiration of the Commission's emergency regulation until the March meeting when the Commission will decide whether or not to list longfin. Therefore, pursuant to Fish and Game Code section 2081, DWR will apply to DFG for a short-term take permit for longfin smelt as a candidate species that covers operations of the SWP during this two-week period.

CESA requires compliance with CEQA for obtaining a take permit of listed species. Therefore, the purpose of the proposed project is to describe SWP operations for protection of longfin smelt necessary to obtain DFG's approval of a take permit for the SWP.

1.4 Required Permits and Approvals

DWR will implement the proposed project in accordance with the statutes and regulations listed above. DFG has approval authority for the proposed issuance of an Incidental Take Permit for longfin smelt, pursuant to Section 2081 of the California Fish and Game Code. No other agencies are expected to exercise approval authority for any elements of this project.

1.5 Document Organization

This IS is organized as described below.

Negative Declaration. The Draft Negative Declaration, which precedes the IS, summarizes the environmental conclusions for the proposed project.

Chapter 1 – Introduction, describes the background, the project objectives for the proposed project, organization of this document, and provides a summary of the environmental analysis findings.

Chapter 2 – Project Description, discusses the physical facilities and operational considerations and conditions that would exist with implementation of the propose project.

Chapter 3 – CEQA Environmental Checklist, identifies the environmental resource topics evaluated based on the CEQA Environmental Checklist and describes the environmental setting, the significance criteria, and the results used to identify the potential environmental impacts associated with implementation of the proposed project.

Chapter 4 – Mandatory Findings of Significance, identifies and summarizes the overall significance of any potential impacts to natural and cultural resources, cumulative impacts, and impact to humans, as identified in the Initial Study.

Chapter 5 – List of Preparers, identifies the individuals who prepared this document.

Chapter 6 – References, lists the sources of information used in completing this IS including literature citations and personal communications.

Appendices

Appendix 1 – Project Area Map, contains a map of the project area and major SWP facilities.

Appendix 2- CalSim II modeling assumptions and results

Appendix 3 – Draft Longfin Smelt Effects Analysis provides an effects assessment of the operations of the SWP on longfin smelt.

1.6 SUMMARY OF FINDINGS

Chapter 3 of this document contains the Environmental Checklist that identifies the potential environmental impacts (by environmental topic) and a brief discussion of each resources topic potentially impacted from implementation of the proposed project.

Based on this IS and the supporting environmental analysis provided in this document, the proposed project would result in no impacts for the following resource areas:

- Aesthetics
- Agricultural Resources
- Air Quality
- Biological Resources (Terrestrial)
- Cultural Resources
- Geology and Soils
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use and Planning
- Mineral Resources
- Noise
- Population and Housing
- Public Services
- Recreation
- Transportation/Traffic
- Utilities and Service Systems

Implementation of the proposed project would result in less-than-significant impacts for the resource topics listed below.

- Biological Resources (Fisheries and Aquatic)

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In accordance with §15064(f)(3) of the CEQA Guidelines, a Negative Declaration shall be prepared if the proposed project will not have a significant effect on the environment. Based on the available project information and the environmental analysis presented in this document, there is no substantial evidence that the proposed project would have a significant effect on the environment. Therefore, it is proposed that a Negative Declaration be adopted in accordance with the CEQA Guidelines.

CHAPTER 2
PROJECT DESCRIPTION

The proposed project is DWR's on-going and long-term operation of the State Water Project (SWP) in the manner consistent with the protection and conservation of the longfin smelt *Spirincus thaleichthys* (Spirin) in compliance with the California Endangered Species Act (CESA) as authorized by the California Department of Fish and Game (DFG) through issuance of a permit for take of longfin smelt pursuant to Section 2081 of CESA (California Fish and Game Code section 2081). The action consists of operation of SWP facilities in accordance with certain actions consistent with the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion of the Operating Criteria and Plan for the Coordinated Operations of the Central Valley Project and State Water Project (USFWS 2008). The action includes operation of SWP facilities from December through June to protect adult longfin smelt migration and spawning and larvae and juvenile rearing. The protection of longfin smelt is achieved through operations undertaken during the same period to protect delta smelt which are sufficient for the protection of longfin smelt because of included adaptive management provisions and the substantial overlap in timing and distribution of these species in the Delta. The specific operations proposed for protection of longfin smelt are described in detail below in the section on Proposed State Water Project Operations for Protection of Longfin Smelt (page 28). Additionally, monitoring measures are described in the section on Minimization Measures for SWP Operations.

DWR is not proposing any additional actions for protection of longfin smelt beyond actions already in place for protection of delta smelt. DWR believes these actions are sufficiently robust and effective in protecting longfin smelt from the effects of SWP operations to authorize take. The actions include a weekly adaptive management process for DFG to provide input on SWP operations for the protection of longfin smelt. If DFG determines that additional protective actions for longfin smelt are needed to approve take authorization under CESA Section 2081, DWR may need to implement additional actions as prescribed. At this time, DWR cannot know if DFG will prescribe additional actions necessary for authorizing take of longfin smelt under section 2081. If any additional protective actions are prescribed and if these actions have the potential to impact the environmental, DWR will undertake additional environmental review as required under CEQA.

Under the proposed project, DWR will continue to deliver SWP water to the SWP contractors within all State and federal environmental regulations. The SWP long-term water supply contracts between DWR and its water contractors define how DWR will, among other provisions, allocate available water supply and costs to its SWP contractors. Under the contracts, as long as regulatory and hydrologic conditions permit, DWR will pump available water from the Delta to meet contractor and operational needs. Exports of SWP water allocated under the long-term water supply contracts, however, must be exported in conformance with SWP water right permits, U.S. Army Corps of Engineers (Corps) permits, State Water Resources Control Board (SWRCB) water quality regulations, Endangered Species Act biological opinions, and any other laws and regulations. Therefore, the proposed project will not result in Delta diversions at the SWP facilities above levels permitted under these regulatory constraints at the specific time of diversion.

Method of Analysis

This CEQA Initial Study/Negative Declaration uses a modeling approach to define the changes in water supply that can occur due to implementation of operational criteria on the SWP. SWP operations are typically described using models to approximate conditions resulting from application of the various requirements. Projected conditions include water supply and various attributes of the areas potentially affected by the operations, including aquatic habitat and water quality constituents. The requirements are defined as a collection of regulatory triggers that operate under varying conditions (e.g., water availability, fish population status). The proposed project or actions are generally described as a range of options identified by modeling the effects of various triggers on the targeted regulatory conditions within a range of historic hydrology. The actual real-time actions are those defined by a process initiated by regulatory-based triggers, informed by real time data collection and evaluation, modeling, and agency coordination. The modeling used in this document is an approach to approximate what could happen in real time under the various conditions based on historical data.

The following sections describe the SWP facilities and operations, and the requirements and processes that collectively define the proposed project or action. The environmental analysis consists of evaluating whether the operations of these facilities to protect longfin smelt will result in a significant effect on the environment. This CEQA document is not evaluating the whole SWP facilities and operations as those have been the subject of past or concurrent environmental review which has resulted in the current project description and operations.

State Water Project

DWR holds contracts with 29 public agencies in Northern, Central, and Southern California for water supplies from the SWP. Water stored in the Oroville facilities, along with excess water available in the Sacramento-San Joaquin Delta is captured in the Delta and conveyed through several facilities to SWP contractors.

The SWP is operated to provide flood control and water for agricultural, municipal, industrial, recreational, and environmental purposes. Water is conserved in Oroville Reservoir and released to serve three Feather River area contractors and two contractors served from the North Bay Aqueduct, and to be pumped at the Harvey O. Banks Pumping Plant (Banks) in the Delta and delivered to the remaining 24 contractors in the SWP service areas south of the Delta. In addition to pumping water released from Oroville Reservoir, the Banks pumps water from other sources entering the Delta.

State Water Project Delta Facilities

North Bay Aqueduct Intake at Barker Slough

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct (NBA) for delivery in Napa and Solano Counties. Maximum pumping capacity is 175 cubic feet per second (cfs) (pipeline capacity). During the past few years, daily pumping rates have ranged between 0 and 140 cfs. The current maximum pumping rate is 140 cfs because an additional pump is required to be installed to reach 175 cfs. In addition, growth of biofilm in a portion of the pipeline is also limiting the NBA ability to reach its full capacity.

The NBA intake is located approximately 10 miles from the main stem Sacramento River at the end of Barker Slough. Per salmon screening criteria, each of the ten NBA pump bays is individually screened with a positive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch. This configuration is designed to exclude fish approximately one inch or larger from being entrained. The bays tied to the two smaller units have an approach velocity of about 0.2 feet per second (ft/s). The larger units were designed for a 0.5 ft/s approach velocity, but actual approach velocity is about 0.44 ft/s. The screens are routinely cleaned to prevent excessive head loss, thereby minimizing increased localized approach velocities.

Delta smelt monitoring was required at Barker Slough under the March 6, 1995 Operating Criteria and Plan (OCAP) BO. Starting in 1995, monitoring was required every other day at three sites from mid- February through mid-July, when delta smelt may be present and continued monitoring was stopped in 2005. As part of the Interagency Ecological Program (IEP), DWR has contracted with the DFG to conduct the required monitoring each year since the biological opinion was issued. Details about the survey and data are available on DFG's website (http://www.delta.dfg.ca.gov/data/NBA).

Beginning in 2008, the NBA larval sampling was replaced by an expanded 20-mm survey (described at http://www.delta.dfg.ca.gov/data/20mm) that has proven to be fairly effective at tracking delta smelt distribution and reducing entrainment. The expanded survey covers all existing 20-mm stations, in addition to a new suite of stations near the NBA. The expanded survey also has an earlier seasonal start and stop date to focus on the presence of larvae in the Delta. The gear type was a surface boom tow, as opposed to oblique sled tows that were traditionally used to sample larval fishes in the San Francisco Estuary. These surveys also collect information on longfin smelt.

Delta Field Division

SWP facilities in the southern Delta include Clifton Court Forebay (CCF), John E. Skinner Delta Fish Protective Facility (Skinner Fish Facility), and the Banks Pumping Plant. CCF is a 31,000 AF reservoir located in the southwestern edge of the Delta, about ten miles northwest of Tracy. CCF provides storage for off-peak pumping, moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels, and collects sediment before it enters the California Aqueduct (CA). Diversions from Old River into CCF are regulated by five radial gates.

The Skinner Fish Facility is located west of the CCF, two miles upstream of the Banks Pumping Plant. The Skinner Fish Facility screens fish away from the pumps that lift water into the CA. Large fish and debris are directed away from the facility by a 388-foot long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers, while the main flow of water continues through the louvers and towards the pumps. These fish pass through a secondary system of screens and pipes into seven holding tanks, where a subsample is counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks.

The Banks Pumping Plant is in the South Delta, about eight miles northwest of Tracy and marks the beginning of the CA. By means of 11 pumps, including two rated at 375 cfs capacity, five at 1,130 cfs capacity, and four at 1,067 cfs capacity, the plant provides the initial lift of water 244 feet into the CA. The nominal capacity of the Banks Pumping Plant is 10,300 cfs.

Other SWP operated facilities in and near the Delta include the North Bay Aqueduct (NBA), the Suisun Marsh Salinity Control Gates (SMSCG), Roaring River Distribution System (RRDS), and up to four temporary barriers in the South Delta. These facilities are discussed further below.

Clifton Court Forebay

Inflows to CCF are controlled by radial gates, whose real-time operations are constrained by a scouring limit (i.e. 12,000 cfs) at the gates and by water level concerns in the South Delta for local agricultural diverters. An interim agreement between DWR and South Delta Water Agency specifies three modes, or “priorities” for CCF gate operation. Of the three priorities, Priority 1 is the most protective of South Delta water levels. Under Priority 1, CCF gates are only opened during the ebb tides, allowing the flood tides to replenish South Delta channels. Priority 2 is slightly less protective because the CCF gates may be open as in Priority 1, but also during the last hour of the higher flood tide and through most of the lower flood tide. Finally, Priority 3 requires that the CCF gates be closed during the rising limb of the higher flood tide and also during the lowest part of the lower tide, but permits the CCF gates to be open at all other times.

When a large head differential exists between the outside and the inside of the gates, theoretical inflow can be as high as 15,000 cfs for a very short time. However, existing operating procedures identify a maximum design flow rate of 12,000 cfs, to minimize water velocities in surrounding South Delta channels, to control erosion, and to prevent damage to the facility.

Maintenance of Clifton Court Forebay - Aquatic Weed Control Program

DWR will apply herbicides or will use mechanical harvesters on an as-needed basis to control aquatic weeds and algal blooms in CCF. Herbicides may include Komeen®, a chelated copper herbicide (copper-ethylenediamine complex and copper sulfate pentahydrate) and Nautique® is a copper carbonate compound (see Sepro product labels). These products are used to control algal blooms so that such algae blooms do not degrade drinking water quality through tastes and odors and production of algal toxins. Dense growth of submerged aquatic weeds, predominantly *Egeria densa*, can cause severe head loss and pump cavitation at Banks Pumping Plant when the stems of the rooted plant break free and drift into the trashracks. This mass of uprooted and broken vegetation essentially forms a watertight plug at the trashracks and vertical louver array. The resulting blockage necessitates a reduction in the pumping rate of water to prevent potential equipment damage through cavitation at the pumps. Cavitation creates excessive wear and deterioration of the pump impeller blades. Excessive floating weed mats also reduce the efficiency of fish salvage at the Skinner Fish Facility. Ultimately, this all results in a reduction in the volume of water diverted by the SWP.

Herbicide treatments will occur only in July and August on an as needed basis in the CCF dependent upon the level of vegetation biomass in the enclosure. Because the treatments will only be during July and August and longfin smelt are not expected to be present in the CCF during this time, adverse effects to longfin smelt are unlikely.

Skinner Fish Facility

The Skinner Fish Facility is located west of the CCF, two miles upstream of the Banks Pumping Plant. The Skinner Fish Facility screens fish away from the pumps that lift water into the CA. Large fish and debris are directed away from the facility by a 388-foot long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers, while the main flow of water continues through the louvers and towards the pumps. These fish pass through a secondary system of screens and pipes into seven holding tanks, where a subsample is counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks.

Banks Pumping Plant

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Suisun Marsh Facilities

Since the early 1970s, the California Legislature, SWRCB, Bureau of Reclamation (Reclamation), DFG, Suisun Resource Conservation District (SRCD), DWR, and other agencies have worked to preserve beneficial uses of Suisun Marsh in mitigation for perceived impacts of reduced Delta Outflow on the salinity regime. Early on, salinity standards were set by the SWRCB to protect alkali bulrush production, a primary waterfowl plant food. The most recent standard under SWRCB Decision 1641 (D-1641) acknowledges that multiple beneficial uses deserve protection.

A contractual agreement between DWR, Reclamation, DFG and SRCD contains provisions for DWR and Reclamation to mitigate the effects on Suisun Marsh channel water salinity from the SWP and Central Valley Project (CVP) operations and other upstream diversions. The Suisun Marsh Preservation Agreement, as amended, (SMPA) requires DWR and Reclamation to meet salinity standards (Stations are illustrated in **Figure 2-1**), sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements. In addition to the contractual agreement, SWRCB Decision 1485 (D-1485) requires DWR and Reclamation to meet specified salinity standards, which are consistent with the SMPA.

There are two primary physical mechanisms for meeting salinity standards set forth in D-1641 and the SMPA: (1) the implementation and operation of physical facilities in the Suisun Marsh; and (2) management of Delta outflow (i.e. facility operations are driven largely by salinity levels upstream of Montezuma Slough and salinity levels are highly sensitive to Delta outflow). Physical facilities (described below) have been operating since the early 1980s and have proven to be a highly reliable method for meeting standards. However, since Delta outflow cannot be actively managed by the SMPA, Suisun facility operations must be adaptive in response to changing salinity levels in the Delta.

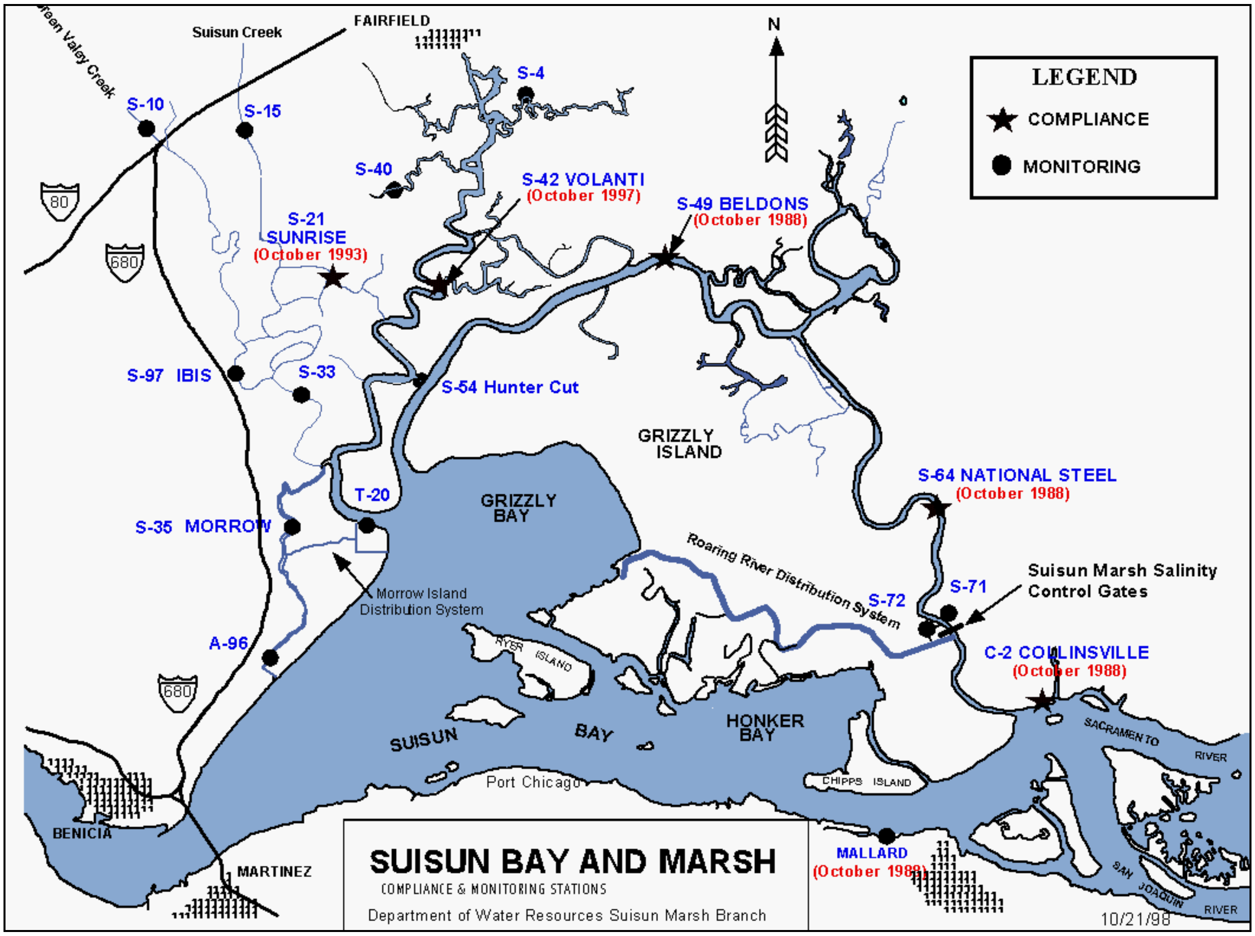


Figure 2-1. Compliance and Monitoring Stations and Salinity Control Facilities in Suisun Marsh

CALFED Charter for Development of an Implementation Plan for Suisun Marsh Wildlife Habitat Management and Preservation

The goal of the CALFED Charter is to develop a regional plan that balances implementation of the CALFED Program, SMPA, and other management and restoration programs within Suisun Marsh. This is to be conducted in a manner that is responsive to the concerns of stakeholders and based upon voluntary participation by private land owners. The Habitat Management, Preservation, and Restoration Plan for the Suisun Marsh (Suisun Marsh Plan) and its accompanying Programmatic Environmental Impact Statement/Report will develop, analyze, and evaluate potential effects of various actions in the Suisun Marsh. The actions are intended to preserve and enhance managed seasonal wetlands, implement a comprehensive levee protection/improvement program, and protect ecosystem and drinking water quality, while restoring habitat for tidal marsh dependent sensitive species, consistent with the CALFED Bay-Delta Program's strategic goals and objectives. USFWS and Reclamation are National Environmental Policy Act (NEPA) co-leads while DFG is the lead State CEQA agency.

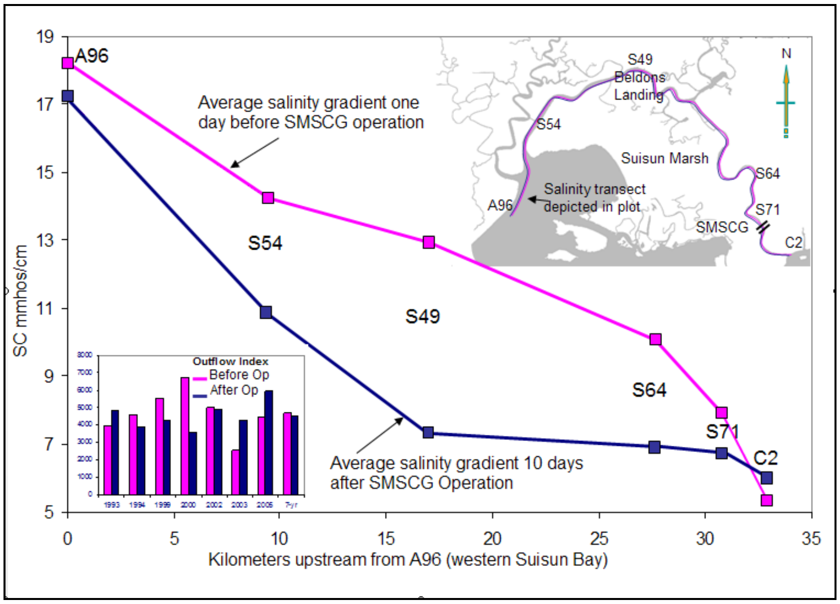
Suisun Marsh Salinity Control Gates

The SMSCG are located on Montezuma Slough about two miles downstream from the confluence of the Sacramento and San Joaquin Rivers, near Collinsville. Operation of the SMSCG began in October 1988 as Phase II of the Plan of Protection for the Suisun Marsh. The objective of SMSCG operation is to decrease the salinity of the water in Montezuma Slough. The facility, spanning the 465-foot width of Montezuma Slough, consists of a boat lock, a series of three radial gates, and removable flashboards. The gates control salinity by restricting the flow of higher salinity water from Grizzly Bay into Montezuma Slough during incoming tides and retaining lower salinity Sacramento River water from the previous ebb tide. Operation of the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of water from east to west.

When Delta outflow is low to moderate and the gates are not operating, tidal flow past the gate is approximately +/- 5,000-6,000 cfs while the net flow is near zero. When operated, flood tide flows are arrested while ebb tide flows remain in the range of 5,000-6,000 cfs. The net flow in Montezuma Slough becomes approximately 2,500-2,800 cfs. The Corps permit for operating the SMSCG requires that it be operated between October and May only when needed to meet Suisun Marsh salinity standards. Historically, the gate has been operated as early as October 1, while in some years (e.g. 1996) the gate was not operated at all. When the channel water salinity decreases sufficiently below the salinity standards, or at the end of the control season, the flashboards are removed and the gates raised to allow unrestricted movement through Montezuma Slough. Details of annual gate operations can be found in “Summary of Salinity Conditions in Suisun Marsh During WYs 1984-1992", or the “Suisun Marsh Monitoring Program Data Summary” produced annually by DWR, Division of Environmental Services.

The approximately 2,800 cfs net flow induced by SMSCG operation is effective at moving the salinity downstream in Montezuma Slough. Salinity is reduced by roughly one-hundred percent at Beldons Landing, and lesser amounts further west along Montezuma Slough. At the same time, the salinity field in Suisun Bay moves upstream as net Delta outflow (measured nominally at Chipps Island) is reduced by gate operation (**Figure 2-2**). Net outflow through Carquinez Strait is not affected. Figure 2-2 indicates the approximate position of X2 (the distance in kilometers up the axis of the Estuary to where the tidally averaged near-bottom salinity is 2 practical salinity units) and how it is transported upstream when the gate is operated.

It is important to note that historical gate operations (1988 – 2002) were much more frequent than recent and current operations (2006 – May 2008) (**Figure 2-3**). Operational frequency is affected by many drivers (hydrologic conditions, weather, Delta outflow, tide, fishery considerations, etc). The gates have also been operated for scientific studies. The gates were operated between 60 and 120 days between October and December during the early years (1988-2004). Salmon passage studies between 1998 and 2003 increased the number of operating days by up to 14 to meet study requirements. After discussions with National Marine Fisheries Service (NMFS) based on study findings, the boat lock portion of the gate is now held open at all times during SMSCG operation to allow for continuous salmon passage opportunity. With increased understanding of the effectiveness of the gates in lowering salinity in Montezuma Slough, salinity standards have been met with less frequent gate operation since 2006. Despite very low outflow in the fall of the two most recent water years, gate operation was not required at all in fall 2007 and was limited to 17 days in winter 2008. Assuming no significant, long-term changes in the drivers mentioned above, this level of operational frequency (10 to 20 days per year) can generally be expected to continue to meet standards in the future except perhaps during the most critical hydrologic conditions and/or other conditions that affect Delta outflow.



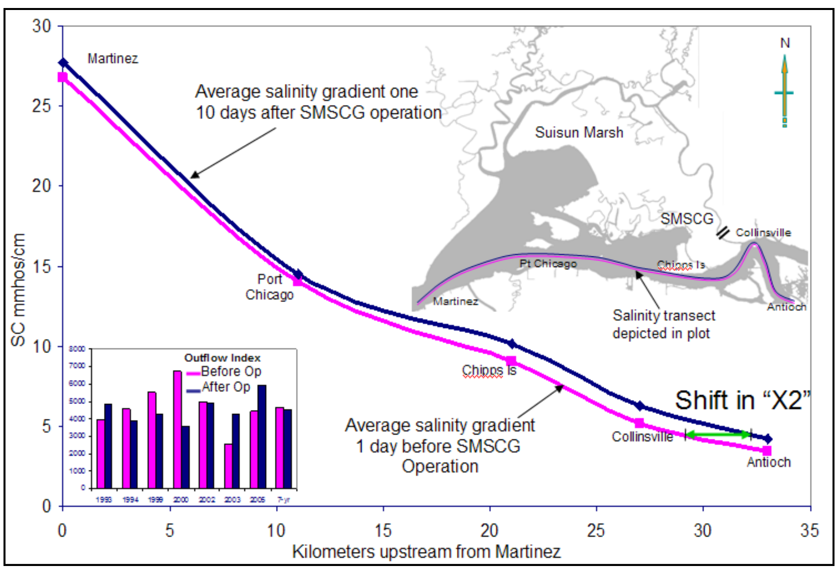


Figure 2-2. Average of Seven Years Salinity Response to SMSCG Gate Operation in Montezuma Slough and Suisun Bay

Note: Magenta line is salinity profile 1 day before gate operation; blue line is salinity 10 days after gate operation.

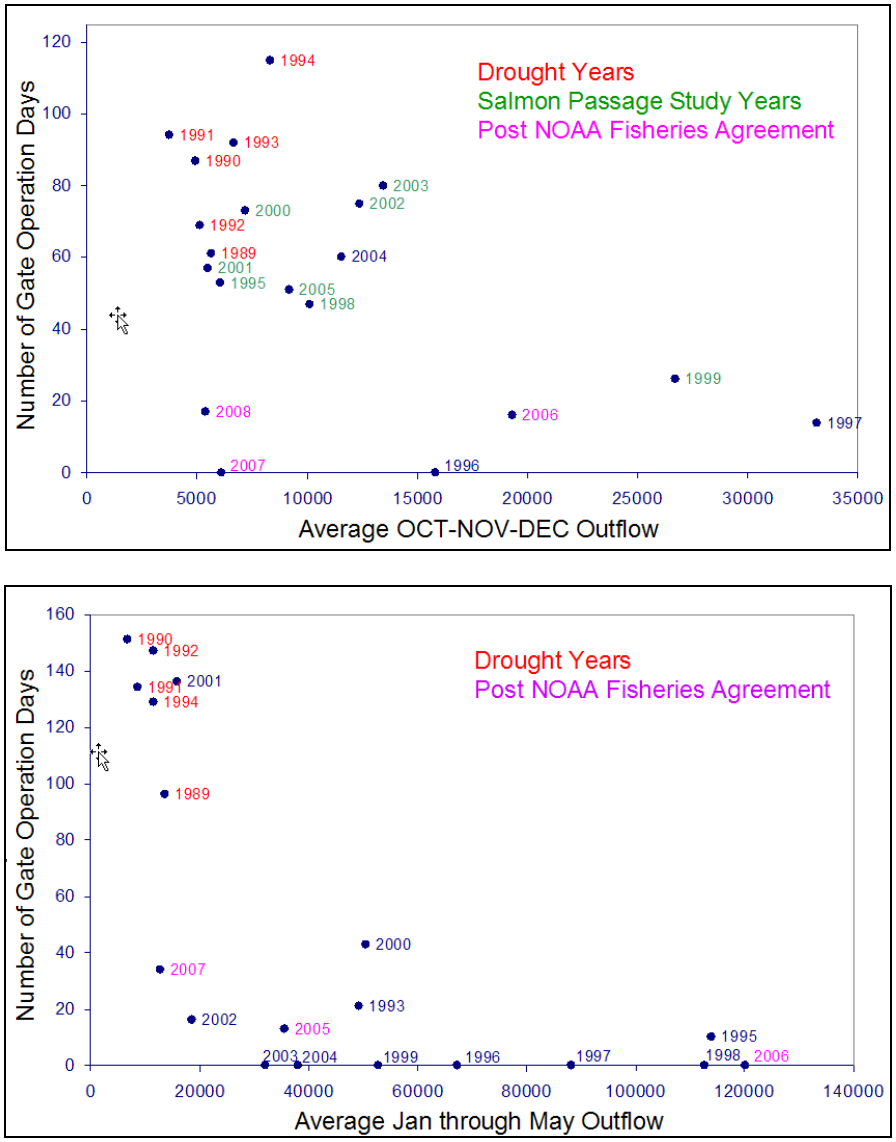


Figure 2-3. SMSCG Operation Frequency Versus Outflow Since 1988

SMSCG Fish Passage Study

The SMSCG were constructed and operate under Permit 16223E58 issued by the Corps, which includes a special condition to evaluate the nature of delays to migrating fish. Ultrasonic telemetry studies in 1993 and 1994 showed that the physical configuration and operation of the gates during the Control Season have a negative effect on adult salmonid passage (Tillman et al. 1996; Edwards et al. 1996).

DWR coordinated additional fish passage studies in 1998, 1999, 2001, 2002, 2003, and 2004. Migrating adult fall-run Chinook salmon were tagged and tracked by telemetry in the vicinity of the SMSCG to assess potential measures to increase the salmon passage rate and decrease salmon passage time through the gates.

Results in 2001, 2003, and 2004 indicate that leaving the boat-lock open during the Control Season when the flashboards are in place at the SMSCG and the radial gates are tidally operated provides a nearly equivalent fish passage to the Non-Control Season configuration when the flashboards are out and the radial gates are open. This approach minimizes delay and blockage of adult Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead migrating upstream during the Control Season while the SMSCG is operating. However, the boatlock gates may be closed temporarily to stabilize flows to facilitate safe passage of watercraft through the facility.

Reclamation and DWR are continuing to coordinate with the SMSCG Steering Committee in identifying water quality criteria, operational rules, and potential measures to facilitate removal of the flashboards during the Control Season that would provide the most benefit to migrating fish. However, the flashboards would not be removed during the Control Season unless it was certain that standards would be met for the remainder of the Control Season without the flashboards installed.

Roaring River Distribution System

The RRDS was constructed during 1979 and 1980 as part of the Initial Facilities in the Plan of Protection for the Suisun Marsh. The system was constructed to provide lower salinity water to 5,000 acres of private and 3,000 acres of DFG-managed wetlands on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly islands.

The RRDS includes a 40-acre intake pond that supplies water to Roaring River Slough. Motorized slide gates in Montezuma Slough and flap gates in the pond control flows through the culverts into the pond. A manually operated flap gate and flashboard riser are located at the confluence of Roaring River and Montezuma Slough to allow drainage back into Montezuma Slough for controlling water levels in the distribution system and for flood protection. DWR owns and operates this drain gate to ensure the Roaring River levees are not compromised during extremely high tides.

Water is diverted through a bank of eight 60-inch-diameter culverts equipped with fish screens into the Roaring River intake pond on high tides to raise the water surface elevation in RRDS above the adjacent managed wetlands. Managed wetlands north and south of the RRDS receive water, as needed, through publicly and privately owned turnouts on the system.

The intake to the RRDS is screened to prevent entrainment of fish larger than approximately 25 mm. DWR designed and installed the screens based on DFG criteria. The screen is a stationary vertical screen constructed of continuous-slot stainless steel wedge wire. All screens have 3/32-inch slot openings. After the listing of delta smelt, RRDS diversion rates have been controlled to maintain an average approach velocity below 0.2 ft/s at the intake fish screen. Initially, the intake culverts were held at about 20 percent capacity to meet the velocity criterion at high tide. Since 1996, the motorized slide gates have been operated remotely to allow hourly adjustment of gate openings to maximize diversion throughout the tide.

Routine maintenance of the system is conducted by DWR and primarily consists of maintaining the levee roads and fish screens. RRDS, like other levees in the marsh, have experienced subsidence since the levees were constructed in 1980. In 1999, DWR restored all 16 miles of levees to design elevation as part of damage repairs following the 1998 flooding in Suisun Marsh. In 2006, portions of the north levee were repaired to address damage following the January 2006 flooding.

Morrow Island Distribution System

The Morrow Island Distribution System (MIDS) was constructed in 1979 and 1980 in the south-western Suisun Marsh as part of the Initial Facilities in the Plan of Protection for the Suisun Marsh. The contractual requirement for Reclamation and DWR is to provide water to the ownerships so that lands may be managed according to approved local management plans. The system was constructed primarily to channel drainage water from the adjacent managed wetlands for discharge into Suisun Slough and Grizzly Bay. This approach increases circulation and reduces salinity in Goodyear Slough (GYS).

The MIDS is used year-round, but most intensively from September through June. When managed wetlands are filling and circulating, water is tidally diverted from Goodyear Slough just south of Pierce Harbor through three 48-inch culverts. Drainage water from Morrow Island is discharged into Grizzly Bay by way of the C-Line Outfall (two 36-inch culverts) and into the mouth of Suisun Slough by way of the M-Line Outfall (three 48- inch culverts), rather than back into Goodyear Slough. This helps prevent increases in salinity due to drainage water discharges into Goodyear Slough. The M-Line ditch is approximately 1.6 miles in length and the C-Line ditch is approximately 0.8 miles in length.

The 1997 USFWS BO issued for dredging of the facility included a requirement for screening the diversion to protect delta smelt. Due to the high cost of fish screens and the lack of certainty surrounding their effectiveness at MIDS, DWR and Reclamation proposed to investigate fish entrainment at the MIDS intake with regard to fishery populations in Goodyear Slough and to evaluate whether screening the diversion would provide substantial benefits to local populations of listed fish species.

To meet contractual commitments, the typical MIDS annual operations are described in detail in the 2008 OCAP Biological Assessment. There are currently no plans to modify operations.

Goodyear Slough Outfall

The Goodyear Slough Outfall was constructed in 1979 and 1980 as part of the Initial Facilities. A channel approximately 69 feet wide was dredged from the south end of Goodyear Slough to Suisun Bay (about 2,800 feet). The excavated material was used for levee construction. The control structure consists of four 48-inch culverts with flap gates on the bay side. On ebb tides, Goodyear Slough receives watershed runoff from Green Valley Creek and, to a lesser extent, Suisun Creek. The system was designed to draw creek flow south into Goodyear Slough, and thereby reduce salinity, by draining water one-way from the lower end of Goodyear Slough into Suisun Bay on the ebb tide. The one-way flap gates at the Outfall close on flood tide keeping saltier bay water from mixing into the slough. The system creates a small net flow in the southerly direction overlaid on a larger, bi-directional tidal flow. The system provides lower salinity water to the wetland managers who flood their ponds with Goodyear Slough water. Another initial facility, the Morrow Island Distribution System, diverts from Goodyear slough and receives lower salinity water. Since the gates are passively operated (in response to water surface elevation differentials) there are no operations schedules or records. The system is open for free fish movement except very near the Outfall when flap gates are closed during flood tides.

South Delta Temporary Barriers Project

The South Delta Temporary Barrier Project (TBP) was initiated by DWR in 1991. Permit extensions were granted in 1996 and again in 2001 to extend the TBP through 2007. DWR recently extended its Corps permit to 2010. The USFWS assessed the operational effects of the TBP in the recent 2008 USFWS Biological Opinion. The NMFS submitted a biological opinion to the Corps in May 2008 which provides incidental take coverage for the continuation of the TBP through 2010.

The project consists of four rock barriers across South Delta channels. In various combinations, these barriers improve water levels and San Joaquin River salmon migration in the South Delta. The existing TBP consists of installation and removal of temporary rock barriers at the following locations:

- Middle River near Victoria Canal, about 0.5 miles south of the confluence of Middle River, Trapper Slough, and North Canal
- Old River near Tracy, about 0.5 miles east of the Delta-Mendota Canal intake
- Grant Line Canal near Tracy Boulevard Bridge, about 400 feet east of Tracy Boulevard Bridge
- The head of Old River at the confluence of Old River and San Joaquin River

The barriers on Middle River, Old River near Tracy, and Grant Line Canal are flow control facilities designed to improve water levels for agricultural diversions and are in place during the growing season. Under the USFWS biological opinion for the Temporary Barriers, operation of the barriers at Middle River and Old River near Tracy can begin May 15, or as early as April 15 if the spring barrier at the head of Old River is in place. From May 16 to May 31 (if the barrier at the head of Old River is removed) the tide gates are tied open in the barriers in Middle River and Old River near Tracy. After May 31, the barriers in Middle River, Old River near Tracy, and Grant Line Canal are permitted to be operational until they are completely removed by November 30.

During the spring, the barrier at the head of Old River is designed to reduce the number of out-migrating salmon smolts entering Old River. During the fall, this barrier is designed to improve flow and dissolved oxygen conditions in the San Joaquin River for the immigration of adult fall-run Chinook salmon. The barrier at the head of Old River barrier is typically in place between April 15 to May 15 for the spring, and between early September to late November for the fall. Installation and operation of the barrier also depends on San Joaquin flow conditions. As required under the 2008 USFWS Delta smelt Biological Opinion, DWR will only install the head of Old River barrier in the Spring if USFWS determines that delta smelt entrainment is not a concern (USFWS Biological Opinion, p. 282).

Proposed Installation and Operations of the Temporary Barriers

The installation and operation of the TBP will continue until the permanent gates are constructed. The proposed installation schedule through 2010 will be identical to the current schedule. In 2008, court rulings to protect delta smelt, prohibited the installation of the spring HOR barrier. As a result, the agricultural barriers installations were delayed according to the current permits until mid-May. As noted above, in the spring, the head of Old River barrier will only be installed if USFWS determines that delta smelt entrainment is not a concern.

To improve water circulation and quality, DWR in coordination with the South Delta Water Agency and Reclamation, began in 2007 to manually tie open the culvert flap gates at the Old River near Tracy barrier to improve water circulation and untie them when water levels fell unacceptably. This operation is expected to continue in subsequent years as needed to improve quality. Adjusting the barrier weir heights is being considered to improve water quality and circulation. DWR will consult with USFWS and NMFS if changes in the height of any or all of the weirs are sought.

If the permanent gates are constructed, temporary barrier operations will continue as planned and permitted. Computer model forecasts, real time monitoring, and coordination with local, State, and Federal agencies and stakeholders will help determine if the temporary rock barriers operations need to be modified during the transition period.

Temporary Barriers Conservation Strategies and Mitigation Measures

DWR has complied with various measures and conditions required by regulatory agencies under past and current permits to avoid, minimize, and compensate for the TBP impacts have been complied with by DWR. An ongoing monitoring plan is implemented each year the barriers are installed and an annual monitoring report is prepared to summarize the activities. The monitoring elements include fisheries monitoring and water quality analysis, Head of Old River fish entrainment and Kodiak trawling study, salmon smolt survival investigations, barrier effects on SWP and CVP entrainment, Swainson's Hawk monitoring, water elevation, water quality sampling, and hydrologic modeling. DWR operates fish screens at Sherman Island.

500 cfs Diversion Increase During July, August, and September

Under this operation, the maximum allowable daily diversion rate into CCF during the months of July, August, and September increases from 13,870 AF to 14,860 AF and three-day average diversions from 13,250 AF to 14,240 AF (500 cfs per day equals 990 AF). The increase in diversions has been permitted and in place since 2000. The last permit expired on September 30, 2008. An application has been made to the Corps for permitting the implementation of this operation. The description of the 500 cfs increased diversion in the permit application to the Corps will be consistent with the following description:

The purpose of this diversion increase into CCF for use by the SWP is to recover export reductions made due to the ESA or other actions taken to benefit fisheries resources. The increased diversion rate will not result in any increase in water supply deliveries than would occur in the absence of the increased diversion rate. This increased diversion over the three-month period would result in an amount not to exceed 90 TAF each year. Increased diversions above the 48 TAF discussed previously could occur for a number of reasons including:

1) Actual carriage water loss on the 60 TAF of current year's Yuba Accord Component 1 Water is less than the assumed 20 percent.

2) Diversion of Yuba Accord Component 1 Water exceeds the current year's 60 TAF allotment to make up for a Yuba Accord Component 1 deficit from a previous year.

3) In very wet years, the diversion of excess Delta outflow goes above and beyond the Yuba Accord Component 1 Water allotment.

Variations to hydrologic conditions coupled with regulatory requirements may limit the ability of the SWP to fully utilize the proposed increased diversion rate. Also, facility capabilities may limit the ability of the SWP to fully utilize the increased diversion rate.

In years where the accumulated export under the 500 cfs increased diversion exceeds 48 TAF, the additional asset will be held in the SWP share of San Luis Reservoir, as long as space is available, to be applied to an export reduction specified by the fish agencies for the immediate water year. For example, if 58 TAF were exported under the increased diversion during July through September, then 10 TAF of additional asset would be in San Luis Reservoir on September 30. The fish agencies may choose to apply this asset to an export reduction during the early winter or take a risk that space for storing the asset will remain in the SWP share of San Luis Reservoir and be available to be applied to the VAMP or post-VAMP export reduction in the spring. If the asset remains available for the VAMP and post-VAMP shoulder, it would increase the export reduction during that period by an equal amount. In this example, the export would be reduced an additional 10 TAF.

As the winter and spring progress, the SWP share of San Luis Reservoir may fill and the space will no longer be available to store the asset. If this happens, the asset will be converted to SWP supply stored in San Luis Reservoir and the SWP exports from the Delta will be reduced at that time by the same volume as the asset. Any reductions in exports resulting from this situation are expected to occur in the December through March period.

Implementation of the proposed action is contingent on meeting the following conditions:

1. The increased diversion rate will not result in an increase in annual SWP water supply allocations other than would occur in the absence of the increased diversion rate. Water pumped due to the increased capacity will only be used to offset reduced diversions that occurred or will occur because of ESA or other actions taken to benefit fisheries.

2. Use of the increased diversion rate will be in accordance with all terms and conditions of existing biological opinions and other permits governing SWP operations.

3. All three temporary agricultural barriers (Middle River, Old River near Tracy and Grant Line Canal) must be in place and operating when SWP diversions are increased.

4. Between July 1 and September 30, prior to the start of or during any time at which the SWP has increased its diversion rate in accordance with the approved operations plan, if the combined salvage of listed fish species reaches a level of concern, real-time decision making will be implemented. The relevant fish regulatory agency will determine whether the 500 cfs increased diversion is or continues to be implemented.

Project Management Objectives

The SWP is managed to maximize the capture of water in the Delta and the usable supply released to the Delta from Oroville Reservoir storage. The maximum daily pumping rate at Banks is controlled by a combination of the D-1641, the real-time decision making to assist in fishery management process described previously, and permits issued by the Corps that regulate the rate of diversion of water into CCF for pumping at Banks. This diversion rate is normally restricted to 6,680 cfs as a three-day average inflow to CCF and 6,993 cfs as a one-day average inflow to CCF. CCF diversions may be greater than these rates between December 15 and March 15, when the inflow into CCF may be augmented by one-third of the San Joaquin River flow at Vernalis when those flows are equal to or greater than 1,000 cfs. Additionally, the SWP has a permit to export an additional 500 cfs between July 1 and September 30 (further details on this pumping are found later in the Project Description). The purpose for the current permitted action is to replace pumping foregone for the benefit of Delta fish species, making the summer limit effectively 7,180 cfs.

The hourly operation of the CCF radial gates is governed by agreements with local agricultural interests to protect water levels in the South Delta area. The radial gates controlling inflow to the forebay may be open during any period of the tidal cycle with the exception of the two hours before and after the low-low tide and the hours leading up to the high-high tide each day. CCF gate operations are governed by agreements and response plans to protect South Delta water users, and a more detailed discussion of these operations and agreement will follow under CCF and Joint Point of Diversion sections.

Banks is operated to minimize the impact to power loads on the California electrical grid to the extent practical, using CCF as a holding reservoir to allow that flexibility. Generally more pump units are operated during off-peak periods and fewer during peak periods. Because the installed capacity of the pumping plant is 10,300 cfs, the plant can be operated to reduce power grid impacts, by running all available pumps at night and a reduced number during the higher energy demand hours, even when CCF is admitting the maximum permitted inflow.

There are years (primarily wetter years) when Banks operations are demand limited, and Banks is able to pump enough water from the Delta to fill San Luis Reservoir and meet all contractor demands without maximizing its pumping capability every day of the year. This has been less likely in recent years, where the contractors request all or nearly their entire contract Table A amount every year. Consequently, current Banks operations are more often supply limited. Under these current full demand conditions, Banks Pumping Plant is almost always operated to the maximum extent possible to maximize the water captured, subject to the limitations of water quality, Delta standards, and a host of other variables, until all needs are satisfied and all storage south of the Delta is full.

San Luis Reservoir is an offstream storage facility located along the CA downstream of Banks. San Luis Reservoir is used by both projects to augment deliveries to their contractors during periods when Delta pumping is insufficient to meet downstream demands. San Luis Reservoir operates like a giant regulator on the SWP system, accepting any water pumped from Banks that exceeds contractor demands, then releasing that water back to the aqueduct system when Banks pumping is insufficient to meet demands. The reservoir allows the SWP to meet peak-season demands that are seldom balanced by Banks pumping.

San Luis Reservoir is generally filled in the spring or even earlier in some years. When it and other SWP storage facilities south of the Delta are full or nearly so, when Banks pumping is meeting all current Table A demands, and when the Delta is in excess conditions, DWR will use any available excess pumping capacity at Banks to deliver Article 21 water to the SWP contractors.

Article 21 water is one of several types of SWP water supply made available to the SWP contractors under the long-term SWP water supply contracts between DWR and the SWP contractors. As its name implies, Article 21 water is provided for under Article 21 of the contracts. Unlike Table A water, which is an allocated annual supply made available for scheduled delivery throughout the year, Article 21 water is an interruptible water supply made available only when certain conditions exist. As with all SWP water, Article 21 water is supplied under existing SWP water rights permits, and is pumped from the Delta under the same environmental, regulatory, and operational constraints that apply to all SWP supplies.

When Article 21 water is available, DWR may only offer it for a short time, and the offer may be discontinued when the necessary conditions no longer exist. Article 21 deliveries are in addition to scheduled Table A deliveries; this supply is delivered to contractors that can, on relatively short notice, put it to beneficial use. Typically, contractors have used Article 21 water to meet needs such as additional short-term irrigation demands, replenishment of local groundwater basins, and storage in local surface reservoirs, all of which provide contractors with opportunities for better water management through more efficient coordination with their local water supplies. When Article 21 of the long-term water supply contracts was developed, both DWR and the contractors recognized that DWR was not capable of meeting the full contract demands in all years because not all of the planned SWP facilities had been constructed.

Article 21 water is typically offered to contractors on a short-term (daily or weekly) basis when all of the following conditions exist: the SWP share of San Luis Reservoir is physically full, or projected to be physically full within approximately one week at permitted pumping rates; other SWP reservoirs south of the Delta are at their storage targets or the conveyance capacity to fill these reservoirs is maximized; the Delta is in excess condition; current Table A demand is being fully met; and Banks has export capacity beyond that which is needed to meet current Table A and other SWP operational demands. The increment of available unused Banks capacity is offered as the Article 21 delivery capacity. Contractors then indicate their desired rate of delivery of Article 21 water. It is allocated in proportion to their Table A contractual quantities if requests exceed the amount offered. Deliveries can be discontinued at any time, when any of the above factors change. In the modeling for Article 21, deliveries are only made in months when the State share of San Luis Reservoir is full. In actual operations, Article 21 may be offered a few days in advance of actual filling. Article 21 water will not be offered until State storage in San Luis Reservoir is either physically full or projected to be physically full within approximately one week at permitted pumping rates. Also, any carried-over Environmental Water Account (EWA) water asset stored in the State share of San Luis Reservoir (whether it be from the use of the 500 cfs or other operational assets) will not be considered part of the SWP storage when determining the availability of Article 21. This will ensure that the carried-over EWA water asset does not result in increased Article 21 deliveries.

During parts of April and May, the Vernalis Adaptive Management Program (VAMP) takes effect as described in the CVP section above. The State and Federal pumps reduce their export pumping to benefit fish in the San Joaquin River system. Around this same time, water demands from both agricultural and M&I contractors are increasing, Article 21 water is usually discontinued, and San Luis supplies are released to the SWP facilities to supplement Delta pumping at Banks, thereby meeting contractor demands. The SWP intends to continue VAMP-type export reductions through 2030 to the extent that the limited EWA assets, (as described in an earlier section) will meet the associated water costs. Chapter 9 of the 2008 OCAP biological assessment (BA) includes an analysis of modeling results that illustrates the frequency on which assets are available under a limited EWA to meet the SWP portion of VAMP.

Immediately following VAMP, a “post –VAMP shoulder” may occur. This action is an extension of the reduced pumping levels that occur during VAMP depending on the availability of EWA and limited EWA assets. Chapter 9 of the 2008 OCAP BA includes an analysis of modeling results that illustrates the frequency on which assets are available under a limited EWA to meet the “post – VAMP shoulder”.

After VAMP and the “post-VAMP shoulder”, Delta pumping at Banks can be increased depending on Delta inflow and Delta standards. By late May, demands usually exceed the restored pumping rate at Banks, and continued releases from San Luis Reservoir are needed to meet contractor demands for Table A water.

During this summer period, DWR is also releasing water from Oroville Reservoir to supplement Delta inflow and allow Banks to export the stored Oroville Reservoir water to help meet demand. These releases are scheduled to maximize export capability and gain maximum benefit from the stored water while meeting fish flow requirements, temperature requirements, Delta water quality, and all other applicable standards in the Feather River and the Delta.

DWR must balance storage between Oroville and San Luis reservoirs carefully to meet flood control requirements, Delta water quality and flow requirements, and optimize the supplies to its contractors consistent with all environmental constraints. Oroville Reservoir may be operated to move water through the Delta to San Luis Reservoir via Banks under different schedules depending on Delta conditions, reservoir storage volumes, and storage targets. Predicting those operational differences is difficult, as the decisions reflect operator judgment based on many real-time factors as to when to move water from Oroville Reservoir to San Luis Reservoir.

As San Luis Reservoir is drawn down to meet contractor demands, it usually reaches its low point in late August or early September. From September through early October, demand for deliveries usually drops below the ability of Banks to divert from the Delta, and the difference in Banks pumping is then added to San Luis Reservoir, reversing its spring and summer decline. From early October until the first major storms in late fall or winter unregulated flow continues to decline and releases from Lake Oroville are restricted (due to flow stability agreements with DFG) resulting in export rates at Banks that are somewhat less than demand typically causing a second seasonal decrease in the SWP's share of San Luis Reservoir. Once the fall and winter storms increase runoff into the Delta, Banks can increase its pumping rate and eventually fill (in all but the driest years) the State portion of San Luis Reservoir before April of the following year.

Water Service Contracts, Allocations, and Deliveries

The following discussion presents the practices of DWR in determining the overall amount of Table A water that can be allocated and the allocation process itself. There are many variables that control how much water the SWP can capture and provide to its contractors for beneficial use.

The allocations were developed from analysis of a broad range of variables that include:

- Volume of water stored in Oroville Reservoir
- Flood operation restrictions at Oroville Reservoir
- End-of-water-year (September 30) target for water stored in Oroville Reservoir
- Volume of water stored in San Luis Reservoir
- End-of-month targets for water stored in San Luis Reservoir
- Snow survey results
- Forecasted runoff
- Feather River flow requirements for fish habitat

- Feather River service area delivery obligations
- Feather River flow for senior water rights river diversions
- Anticipated depletions in the Sacramento River basin
- Anticipated Delta conditions
- Precipitation and streamflow conditions since the last snow surveys and forecasts
- Contractor delivery requests and delivery patterns

From these and other variables, the Operations Control Office within DWR estimates the water supply available to allocate to contractors and meet other project needs. The Operations Control Office transmits these estimates to the SWP Analysis Office, where staff enters the water supply, contractor requests, and Table A amounts into a spreadsheet and computes the allocation percentage that would be provided by the available water supply.

The staffs of the Operations Control Office and SWP Analysis Office meet with DWR senior management, usually including the Director, to make the final decision on allocating water to the contractors. The decision is made, and announced in a press release followed by Notices to Contractors.

The initial allocation announcement is made by December 1 of each year. The allocation of water is made with a conservative assumption of future precipitation, and generally in graduated steps, carefully avoiding over-allocating water before the hydrologic conditions are well defined for the year.

Both the DWR and the contractors are conservative in their estimates, leading to the potential for significant variations between projections and actual operations, especially under wet hydrologic conditions.

Other influences affect the accuracy of estimates of annual demand for Table A and the resulting allocation percentage. One factor is the contractual ability of SWP contractors to carry over allocated but undelivered Table A from one year to the next if space is available in San Luis Reservoir. Contractors will generally use their carryover supplies early in the calendar year if it appears that San Luis reservoir will fill. By using the prior year’s carryover, the contractors reduce their delivery requests for the current year’s Table A allocation and instead schedule delivery of carryover supplies.

Carryover supplies left in San Luis Reservoir by SWP contractors may result in higher storage levels in San Luis Reservoir at December 31 than would have occurred in the absence of carryover. If there were no carryover privilege, contractors would seek to store the water within their service areas or in other storage facilities outside of their service areas. As project pumping fills San Luis Reservoir, the contractors are notified to take or lose their carryover supplies. If they can take delivery of and use or store the carryover water, San Luis Reservoir storage then returns to the level that would have prevailed absent the carryover program.

If the contractors are unable to take delivery of all of their carryover water, that water then converts to project water as San Luis Reservoir fills, and Article 21 water becomes available for delivery to contractors.

Article 21 water delivered early in the calendar year may be reclassified as Table A later in the year depending on final allocations, hydrology, and contractor requests. Such reclassification does not affect the amount of water carried over in San Luis Reservoir, nor does it alter pumping volumes or schedules. The total water exported from the Delta and delivered by the SWP in any year is a function of a number of variables that is greater than the list of variables shown above that help determine Table A allocations.

If there are no carryover or Article 21 supplies available, Table A requests will be greater in the January-April period, and there would be a higher percentage allocation of Table A for the year than if carryover and Article 21 were available to meet demand.

Monterey Agreement

In 1994, DWR and certain representatives of the SWP contractors agreed to a set of principles known as the Monterey Agreement, to settle long-term water allocation disputes, and to establish a new water management strategy for the SWP. This project description only includes the system-wide water operations consistent with the Monterey Agreement and not the specific actions by DWR and State Water Contractors needed to implement the agreement.

The Monterey Agreement resulted in 27 of the 29 SWP contractors signing amendments to their long-term water supply contracts in 1995, and the Monterey Amendment has been implemented as part of SWP operations for these 27 SWP contractors since 1996. The original Environmental Impact Report prepared for the Monterey Agreement was challenged, and the EIR was required to be decertified. DWR is currently preparing an EIR on the Monterey Amendment following that litigation and approval of a settlement agreement with the plaintiffs in May 2003. A draft of the new EIR was released in October 2007, the comment period closed in January 2008, and a final EIR is scheduled for completion in March 2009.

The alternatives evaluated in the EIR include continuation of the Monterey Amendment, certain No Project alternatives that would revert some contract terms to pre-Monterey Amendment terms, and two “court ordered no-project” alternatives that would impose a reduction in Table A supplies by implementing a permanent shortage provision together with an offsetting increase in the supply of Article 21 water.

Adoption of any of the alternatives would not measurably change SWP Delta operations, although the internal classification of water provided to SWP contractors could change as to the balance between Table A and Article 21 water, as could the relative allocation of water between urban and agricultural contractors. The Monterey Amendment provides for certain transfers of water from agricultural to urban contractors; impacts from those transfers are all south of the Delta and have no effect on the Delta.

The only impact of Monterey Amendment operations on Delta exports is identified in the draft EIR as the facilitation of approval for out-of-service-area storage programs. Because DWR had previously approved water storage programs outside of individual SWP contractor’s service areas and many such storage programs now exist, this water management method is unlikely to be voided by future actions of DWR. These increased exports can only occur if they are within the diversions permitted at the time. None of the alternatives being considered would result in demand for added Delta diversions above currently assumed levels and all are subject to whatever regulatory restrictions are in force at the time.

Changes in DWR's Allocation of Table A Water and Article 21 Water

The Monterey Amendment revised the temporary shortage provision that specified an initial reduction of supplies for agricultural use when requests for SWP water exceeded the available supply. The Amendment specifies that whenever the supply of Table A water is less than the total of all contractors' requests, the available supply of Table A water is allocated among all contractors in proportion to each contractor's annual Table A amount.

The Monterey Amendment amended Article 21 by eliminating the category of scheduled "surplus water," which was available for scheduled delivery and by renaming "unscheduled water" to "interruptible water." Surplus water was scheduled water made available to the contractors when DWR had supplies beyond what was needed to meet Table A deliveries, reservoir storage targets, and Delta regulatory requirements. Surplus water and unscheduled water were made available first to contractors requesting it for agricultural use or for groundwater replenishment. Because of the contractors' increasing demands for Table A water and the increasing regulatory requirements imposed on SWP operations, DWR is now able to supply water that is not Table A water only on an unscheduled, i.e., interruptible basis.

Pursuant to the revised Article 21, DWR allocates the available interruptible supply to requesting contractors in proportion to their annual Table A amounts.

The result of these contractual changes are that DWR now allocates Table A and interruptible water among contractors in proportion to annual Table A amounts without consideration of whether the water would be used for M&I or agricultural purposes. Agricultural and M&I contractors share any reductions in deliveries or opportunities for surplus water in proportion to their annual Table A amounts.

Historical Water Deliveries to Southern California

The pumping from the Delta to serve southern California has been influenced by changes in available water supply sources to serve the region. The Colorado River and the SWP have been the major supply sources for southern California.

The Quantification Settlement Agreement (QSA) signed in 2003 resulted in a decrease in the amount of Colorado River water available to California. Since 1998, the Metropolitan Water District of Southern California (MWDSC) has filled Diamond Valley Lake (810,000 acre-feet, late 1998-early 2002) and adding some water to groundwater storage programs. In wetter years, demand for imported water may often decrease because local sources are augmented and local rainfall reduces irrigation demand.

Transfers

Transfers requiring export from the Delta are done at times when pumping and conveyance capacity at Banks or Jones is available to move the water. Additionally, operations to accomplish these transfers must be carried out in coordination with CVP and SWP operations, such that the capabilities of the Projects to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way.

In particular, parties to the transfer are responsible for providing for any incremental changes in flows required to protect Delta water quality standards. All transfers will be in accordance with all existing regulations and requirements.

Purchasers of water for water transfers may include Reclamation, DWR, SWP contractors, CVP contractors, other State and Federal agencies, or other parties. DWR and Reclamation have operated water acquisition programs in the past to provide water for environmental programs and additional supplies to SWP contractors, CVP contractors, and other parties. The DWR programs include the 1991, 1992, and 1994 Drought Water Banks and Dry Year Programs in 2001 and 2002. Reclamation operated a forbearance program in 2001 by purchasing CVP contractors' water in the Sacramento Valley for CVPIA in-stream flows, and to augment water supplies for CVP contractors south of the Delta and wildlife refuges. Reclamation administers the Central Valley Project Improvement Act (CVPIA) Water Acquisition Program for Refuge Level 4 supplies and fishery in-stream flows. The CALFED Ecosystem Restoration Program will, in the future, acquire water for fishery and ecosystem restoration. DWR, and potentially Reclamation in the future, has agreed to participate in a Yuba River Accord that will provide fish flows on the Yuba River and also water supply that may be transferred at DWR and Reclamation Delta facilities. It is anticipated that Reclamation will join in the Accord and fully participate in the Yuba Accord upon completion of the OCAP consultation. The Yuba River Accord water would be transferred to offset VAMP water costs.

Also in the past, CVP and SWP contractors have also independently acquired water and arranged for pumping and conveyance through SWP facilities. State Water Code provisions grant other parties access to unused conveyance capacity, although SWP contractors have priority access to capacity not being used by the DWR to meet SWP contract amounts.

The Yuba River Accord includes three separate but interrelated agreements that would protect and enhance fisheries resources in the lower Yuba River, increase local water supply reliability, and provide DWR with increased operational flexibility for protection of Delta fisheries resources through Project re-operation, and provision of added dry-year water supplies to State and Federal water contractors. These proposed agreements are the:

- Principles of Agreement for Proposed Lower Yuba River Fisheries Agreement (Fisheries Agreement)

- Principles of Agreement for Proposed Conjunctive Use Agreements (Conjunctive Use Agreements)

- Principles of Agreement for Proposed Long-term Transfer Agreement (Water Purchase Agreement)

The Fisheries Agreement was developed by State, Federal, and consulting fisheries biologists, fisheries advocates, and policy representatives. Compared to the interim flow requirements of the SWRCB Revised Water Right Decision 1644, the Fisheries Agreement would establish higher minimum instream flows during most months of most water years.

Transfer Capacity

DWR assumes as part of the project description that the water transfer programs for environmental and water supply augmentation will continue in some form, and that in most years (all but the driest), the scope of annual water transfers will be limited by available Delta pumping capacity, and exports for transfers will be limited to the months July through September. As such, looking at an indicator of available transfer capacity in those months is one way of estimating an upper boundary to the effects of transfers on an annual basis.

The CVP and SWP may provide Delta export pumping for transfers using pumping capacity at Banks and Jones beyond that which is being used to deliver project water supply, up to the physical maximums of the pumps, consistent with prevailing operations constraints such as Export to Inflow (E/I) ratio, conveyance or storage capacity, and any protective criteria in effect that may apply as conditions on such transfers. For example, pumping for transfers may have conditions for protection of Delta water levels, water quality, fisheries, or other beneficial uses.

The surplus capacity available for transfers will vary a great deal with hydrologic conditions. In general, as hydrologic conditions get wetter, surplus capacity diminishes because the CVP and SWP are more fully using export pumping capacity for Project supplies. CVP's Jones Pumping Plant, with no forebay for pumped diversions and with limited capability to fine tune rates of pumping, has little surplus capacity, except in the driest hydrologic conditions. The SWP has the most surplus capacity in critical and some dry years, less or sometimes none in a broad middle range of hydrologic conditions, and some surplus again in some above normal and wet years when demands may be lower because contractors have alternative supplies.

The availability of water for transfer and the demand for transfer water may also vary with hydrologic conditions. Accordingly, since many transfers are negotiated between willing buyers and sellers under prevailing market conditions, price of water also may be a factor determining how much is transferred in any year. This document does not attempt to identify how much of the available and useable surplus export capacity of the CVP and SWP will actually be used for transfers in a particular year, but recent history, the expectations for the future limited EWA, and the needs of other transfer programs suggest a growing reliance on transfers.

Under both the present and future conditions, capability to export transfers will often be capacity-limited, except in Critical and some Dry years. In these Critical and some Dry years, both Banks and Jones have more available capacity for transfers, so export capacity is less likely to limit transfers. Rather, either supply or demand for transfers may be a limiting factor. During such years, low project exports and high demand for water supply could make it possible to transfer larger amounts of water.

Proposed Exports for Transfers

Although transfers may occur at any time of year, proposed exports for transfers apply only to the months July through September. For transfers outside those months, or in excess of the proposed amounts, Reclamation and DWR would request separate consultation. In consideration of the estimates of available capacity for export of transfers during July through September, and in recognition of the many other possible operations contingencies and constraints that may limit actual use of that capacity for transfers, the proposed use of SWP/CVP export capacity for transfers in thousand acre-feet (TAF) is as follows:

Water Year Class	Maximum Transfer Amount
Critical	up to 600 TAF
Dry (following Critical)	up to 600 TAF
Dry (following Dry)	up to 600 TAF
All other Years	up to 360 TAF

Environmental Water Account

The EWA was established in 2000 by the CALFED record of decision (ROD), and operating criteria are described in detail in the EWA Operating Principles Agreement attachment to the ROD. In 2004, the EWA was extended to operate through the end of 2007. Reclamation, the Service, and NMFS have received Congressional authorization to participate in the EWA at least through September 30, 2010, per the CALFED Bay-Delta Authorization Act (PL-108-361). However, for these Federal agencies to continue participation in the EWA beyond 2010, additional authorization will be required.

The original purpose of the EWA was to enable diversion of water by the SWP and CVP from the Delta to be reduced at times when at risk fish species may be harmed while preventing the uncompensated loss of water to SWP and CVP contractors. Typically the EWA replaced water loss due to curtailment of pumping by purchase of surface or groundwater supplies from willing sellers and by taking advantage of regulatory flexibility and certain operational assets. Under past operations, from 2001 through 2007, when there were pumping curtailments at Banks Pumping Plant to protect Delta fish the EWA often owed a debt of water to the SWP, usually reflected in San Luis Reservoir.

The EWA agencies (the Project and fisheries agencies – DWR, Reclamation, and USFWS, NMFS, and DFG) are currently undertaking environmental review to determine the future of EWA. Because no decision has yet been made regarding EWA, for the purposes of this project description, EWA is analyzed with limited assets, focusing on providing assets to support VAMP and in some years, the “post – VAMP shoulder”. The EWA assets include the following:

- Implementation of the Yuba Accord Component 1 Water, which is an average 60,000 AF of water released annually from the Yuba River to the Delta, is an EWA asset through 2015, with a possible extension through 2025. The 60,000 AF is expected to be reduced by carriage water costs in most years, estimated at 20 percent, leaving an EWA asset of 48,000 AF per year. The SWP will provide the 48,000 AF per year asset from Project supplies beyond 2015 in the event that Yuba Accord Component 1 Water is not extended.

- Purchases of assets to the extent funds are available.

- Operational assets granted the EWA in the CALFED ROD:

    - A 50 percent share of SWP export pumping of (b)(2) water and Ecosystem Restoration Program (ERP) water from upstream releases;

    - A share of the use of SWP pumping capacity in excess of the SWP’s needs to meet contractor requirements with the CVP on an equal basis, as needed (such use may be under Joint Point of Diversion);

    - Any water acquired through export/inflow ratio flexibility; and

    - Use of 500 cfs increase in authorized Banks Pumping Plant capacity in July through September (from 6,680 to 7,180 cfs).

- Storage in Project reservoirs upstream of the Delta as well as in San Luis Reservoir, with a lower priority than Project water. Such stored water will share storage priority with water acquired for Level 4 refuge needs.

Operational assets averaged 82,000 AF from 2001-2006, with a range from 0 to 150,000 AF.

Delta Operations Regulatory Setting

State Water Resources Control Board Water Rights

1995 Water Quality Control Plan

The SWRCB adopted the 1995 Bay-Delta Water Quality Control Plan (WQCP) on May 22, 1995, which became the basis of SWRCB Decision-1641. The SWRCB continues to hold workshops and receive information regarding processes on specific areas of the 1995 WQCP. The SWRCB amended the WQCP in 2006, but to date, the SWRCB has made no significant changes to the 1995 WQCP framework. See discussion of revised WQCP (2006) below.

Decision 1641

The SWRCB imposes a myriad of constraints upon the operations of the CVP and SWP in the Delta. With D-1641, the SWRCB implements the objectives set forth in the SWRCB 1995 Bay-Delta WQCP and imposes flow and water quality objectives upon the Projects to assure protection of beneficial uses in the Delta. The SWRCB also grants conditional changes to points of diversion for the Projects with D-1641.

The various flow objectives and export restraints are designed to protect fisheries. These objectives include specific outflow requirements throughout the year, specific export restraints in the spring, and export limits based on a percentage of estuary inflow throughout the year. The water quality objectives are designed to protect agricultural, municipal and industrial, and fishery uses, and they vary throughout the year and by the wetness of the year. These objectives will remain in place until such time that the SWRCB revisits them per petition or as a consequence to revisions to the SWRCB Water Quality Plan for the Bay-Delta (which is to be revisited periodically).

On December 29, 1999, SWRCB adopted and then revised (on March 15, 2000) D-1641, amending certain terms and conditions of the water rights of the SWP and CVP. D-1641 substituted certain objectives adopted in the 1995 Bay-Delta Plan for water quality objectives that had to be met under the water rights of the SWP and CVP. In effect, D-1641 obligates the SWP and CVP to comply with the objectives in the 1995 Bay-Delta Plan. The requirements in D-1641 address the standards for fish and wildlife protection; M&I water quality, agricultural water quality, and Suisun Marsh salinity. SWRCB D-1641 also authorizes SWP and CVP to jointly use each other's points of diversion in the southern Delta, with conditional limitations and required response coordination plans. SWRCB D-1641 modified the Vernalis salinity standard under SWRCB Decision 1422 to the corresponding Vernalis salinity objective in the 1995 Bay- Delta Plan.

Revised WQCP (2006)

The SWRCB undertook a proceeding under its water quality authority to amend the WQCP for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay- Delta Plan) adopted in 1978 and amended in 1991 and in 1995. Prior to commencing this proceeding, the SWRCB conducted a series of workshops in 2004 and 2005 to receive information on specific topics addressed in the Bay-Delta Plan.

The SWRCB adopted a revised Bay-Delta Plan on December 13, 2006. There were no changes to the Beneficial Uses from the 1995 Plan to the 2006 Plan, nor were any new water quality objectives adopted in the 2006 Plan. A number of changes were made simply for readability. Consistency changes were also made to assure that sections of the 2006 Plan reflected the current physical condition or current regulation. The SWRCB continues to hold workshops and receive information regarding Pelagic Organism Decline (POD), Climate Change, and San Joaquin salinity and flows, and will coordinate updates of the Bay-Delta Plan with on-going development of the comprehensive Salinity Management Plan.

Minimization Measures for SWP Operations

Reasonable and Prudent Measures (RPMs) are included in the 2008 USFWS BO and DWR incorporates these measures into the SWP proposed project as minimization measures for the protection of longfin smelt.

1) To minimize adverse effects of operations of the NBA, annual evaluations shall be conducted for the fish screens at the NBA diversion during January through June. A proposed evaluation study shall be submitted to the DFG for approval within 3 months of the issuance of this biological opinion permit. The evaluation shall monitor fish entrained and impinged on the fish screen, the screen approach velocities, cleanliness of the screen and any other pertinent criteria needed to determine the effectiveness of the fish screen.

3) To obtain real time data on the abundance and distribution of longfin smelt in the Bay-Delta, during the months of December through July, when water is being diverted DWR shall ensure that the frequency of sampling for longfin smelt at Banks will be at least 25 percent of the time.

DWR shall develop a methodology for quantitative longfin larval monitoring at Banks to help refine the triggers for the Actions in Components of the Reasonable and Prudent Alternative (RPA) described below under the Proposed SWP Operations to Protect Longfin Smelt. An interim plan shall be submitted to the DFG for approval within 30 days of the issuance of the permit so the monitoring can be implemented this year. A more detailed plan shall be developed and approved by the DFG within one year.

4) To minimize adverse effects of Banks on longfin smelt, DWR will develop within 30 days a methodology for dealing with transitions in operations after changes in OMR flow requirements.

Monitoring requirements will be implemented by DWR, in cooperation with Reclamation.

Reporting Requirements

DWR will immediately report to the DFG any information about take or suspected take of longfin smelt. DWR will notify the DFG within 24 hours of receiving such information. Notification must include the date, time, and location of the incident or of the finding of a dead or injured longfin smelt and will be processed according to DFG protocols.

Real Time Decision-Making to Assist Fishery Management

Real time decision-making to assist fishery management is a process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. For the proposed action high uncertainty exists for how to best manage water operations while protecting listed species. Sources of uncertainty relative to the proposed action include:

- Hydrologic conditions
- Ocean conditions
- Listed species biology

Under the proposed action the goals for real time decision-making to assist fishery management are:

- Meet contractual obligations for water delivery
- Minimize adverse effects for listed species

DWR works closely with USFWS, NMFS, and DFG to coordinate the operation of the SWP with fishery needs. This coordination is facilitated through several forums in a cooperative management process that allows for modifying operations based on real-time data that includes current fish surveys, flow and temperature information, and salvage or loss at the project facilities, (hereinafter “triggering event”).

Water Operations Management Team

The Water Operations Management Team (WOMT) is comprised of representatives from Reclamation, DWR, USFWS, NMFS, and DFG. This management-level team was established to facilitate timely decision-support and decision-making at the appropriate level. The WOMT first met in 1999, and will continue to meet to make management decisions as part of the proposed action. Routinely, it also uses the CALFED Ops Group to communicate with stakeholders about its decisions. Although the goal of WOMT is to achieve consensus on decisions, the participating agencies retain their authorized roles and responsibilities.

Process for Real Time Decision- Making to Assist Fishery Management

Decisions regarding SWP operations to avoid and minimize adverse effects on listed species must consider factors that include public health, safety, water supply reliability, and water quality. To facilitate such decisions, DWR, Reclamation, USFWS, NMFS, and DFG have developed and refined a set of processes for various fish species to collect data, disseminate information, develop recommendations, make decisions, and provide transparency. This process consists of three types of groups that meet on a recurring basis. Management teams are made up of management staff from Reclamation, DWR, USFWS, NMFS, and DFG. Information teams are teams whose role is to disseminate and coordinate information among agencies and stakeholders. Fisheries and Operations Technical Teams are made up of technical staff from State and Federal agencies. These teams review the most up-to-date data and information on fish status and Delta conditions, and develop recommendations that fishery agencies' management can use in identifying actions to protect listed species.

The process to identify actions for protection of listed species varies to some degree among species but follows this general outline: A Fisheries or Operations Technical Team compiles and assesses current information regarding species, such as stages of reproductive development, geographic distribution, relative abundance, and physical habitat conditions; it then provides a recommendation to the agency with statutory obligation to enforce protection of the species in question. The agency's staff and management will review the recommendation and use it as a basis for developing, in cooperation with Reclamation and DWR, a modification of water operations that will minimize adverse effects to listed species by the Projects. If DWR and Reclamation do not agree with the action, then the fishery agency with the statutory authority will make a final decision on an action that they deem necessary to protect the species.

The outcomes of protective actions that are implemented will be monitored and documented, and this information will inform future recommended actions.

Groups Involved in Real Time Decision-Making to Assist Fishery Management and Information Sharing

The following teams assist with the collection of data and recommend changes to operations for the protection of longfin smelt.

CALFED Ops and Subgroups

The CALFED Ops Group consists of the Project agencies (DWR and Reclamation), the fishery agencies (USFWS, NMFS, and DFG), SWRCB staff, and the U.S. Environmental Protection Agency (EPA). The CALFED Ops Group generally has met eleven times a year in a public setting so that the agencies can inform each other and stakeholders about current the operations of the CVP and SWP, implementation of the CVPIA and State and Federal endangered species acts, and additional actions to contribute to the conservation and protection of State- and Federally-listed species. The CALFED Ops Group held its first public meeting in January 1995, and during the next six years the group developed and refined its process. The CALFED Ops Group has been recognized within SWRCB D-1641, and elsewhere, as one forum for coordination on decisions to exercise certain flexibility that has been incorporated into the Delta standards for protection of beneficial uses (e.g., E/I ratios, and some Delta Cross Channel [DCC] closures). Several groups or teams were established through the Ops Group process. Several fisheries specific teams have been established to provide guidance and recommendations on resource management issues. The group and team that relates to longfin smelt includes:

Data Assessment Team (DAT)

The DAT consists of technical staff members from the Project and fishery agencies as well as stakeholders. The DAT meets frequently during the fall, winter, and spring. The purpose of the meetings is to coordinate and disseminate information and data among agencies and stakeholders that is related to water project operations, hydrology, and fish surveys in the Delta.

Smelt Working Group (SWG)

The SWG evaluates biological and technical issues regarding delta smelt and develops recommendations for consideration by USFWS. Since the longfin smelt (*Spirinchus thaleichthys*) became a state candidate species in 2008, the SWG has also developed for DFG recommendations to minimize adverse effects to longfin smelt. The SWG consists of representatives from USFWS, DFG, DWR, EPA, and Reclamation. USFWS chairs the group, and members are assigned by each agency.

The SWG compiles and interprets the latest near real-time information regarding state- and federally-listed smelt, such as stages of development, distribution, and salvage. After evaluating available information and if they agree that a protection action is warranted, the SWG will submit their recommendations in writing to USFWS and DFG.

The SWG may meet at any time at the request of USFWS, but generally meets weekly during the months of December through June, when smelt salvage at Jones and Banks has occurred historically. However, the Delta Smelt Risk Assessment Matrix (see below) outlines the conditions when the SWG will convene to evaluate the necessity of protective actions and provide USFWS with a recommendation. Further, with the State listing of longfin smelt, the group will also convene based on longfin salvage history at the request of DFG.

State Water Project Operations for Protection of Longfin Smelt

DWR will implement the actions that are described as the three components (Components 1, 2 and 5) of the Reasonable and Prudent Alternative (RPA) in the December 15, 2008 USFWS BO on Delta Smelt and its Critical Habitat for the protection of longfin smelt. The components are to be implemented using an adaptive approach within specific constraints described below. The components presented are based on the best available scientific information regarding what is necessary to adequately provide for successful longfin smelt migration and spawning, and larval and juvenile survival, growth, rearing, and recruitment within the Bay-Delta. Supporting documentation is provided in Appendix 3 (Draft Longfin Smelt Effects Analysis) of this Initial Study and the USFWS Biological Opinion and Appendices (USFWS 2008).

The specific flow requirements, action triggers and monitoring stations prescribed in below will be continuously monitored and evaluated consistent with the adaptive process. As new information becomes available, these action triggers may be modified without necessarily requiring re-consultation on the overall proposed action.

The following actions are necessary to ensure that implementation of the long term operations of the SWP does not appreciably reduce the likelihood of both the survival and recovery of the longfin smelt through: (1) preventing/reducing entrainment of longfin smelt at Banks; (2) providing adequate habitat conditions that will allow the longfin smelt to successfully migrate and spawn in the Bay-Delta; (3) providing adequate habitat conditions that will allow larvae and juvenile longfin smelt to rear; and (4) providing suitable habitat conditions that will allow successful recruitment of juvenile longfin smelt to adulthood. In addition, it is essential to monitor longfin smelt abundance and distribution through continued sampling programs through the IEP. Through these actions, DWR will minimize the effects of the SWP operations on longfin smelt.

Process for Determining Specific Actions within Components 1 and 2

The following process for determining specific actions within Components 1 and 2 of the delta smelt Biological Opinion (USFWS 2008) will be used to protect longfin smelt. DWR has included in this process that DFG would have authority for final decision-making regarding the needs of longfin smelt. This modification is consistent with the purpose of the adaptive management process through which the fish agencies will consider the needs of other listed species to avoid unnecessary impacts to these species.

1. Within one day after the SWG recommends an action should be initiated, changed, suspended or terminated, the SWG shall provide to USFWS and DFG a written recommendation and a biological justification. The SWG shall use the process described in Attachments A and B of the 2008 USFWS OCAP BO to provide a framework for their recommendations. USFWS and DFG shall determine whether the proposed action should be implemented, changed, or terminated and the OMR needed to achieve the protection. USFWS and DFG shall present this information to the WOMT.

2. The WOMT shall concur with the recommendation or provide a written alternative to the recommendation to USFWS and DFG within one day. USFWS and DFG shall then make a final determination on the proposed action to be implemented, which shall be documented and posted on the Sacramento Fish and Wildlife Service's webpage.

3. Once USFWS and DFG make a final determination to initiate a new action, it shall be implemented within two days by the Projects, and shall remain in effect until it is terminated or replaced, as determined by USFWS, consistent with the description of the RPA and with Attachment B. Data demonstrating the implementation of the action shall be provided to USFWS and DFG weekly.

4. When an action is ongoing, but USFWS and DFG determine that an OMR flow change is required, the Projects shall adjust operations to the new OMR within two days of receipt of the determination. This new OMR flow shall be used until it is readjusted or the action is changed or terminated based on new information, as described in the RPA and Attachment B.

RPA Component 1: Protection of the Adult Delta/Longfin Smelt Life Stage

Delta and longfin smelt are entrained at the fish facilities each year. These actions are designed to reduce the delta/longfin smelt entrainment losses. The objective of Component 1 (Actions 1 and 2 in Attachment B of USFWS 2008) is to reduce entrainment of pre-spawning adult delta/longfin smelt during December to March by controlling OMR flows during vulnerable periods. Action 1 is designed to protect upmigrating delta/longfin smelt. Action 2 is designed to protect adult delta/longfin smelt that have migrated upstream and are residing in the Delta prior to spawning. Overall, RPA Component 1 will increase the suitability of spawning habitat for delta/longfin smelt by decreasing the amount of Delta habitat affected by the projects' export pumping plants' operations prior to, and during, the critical spawning period.

Beginning in December of each year, the DFG and USFWS shall review data on flow, turbidity, salvage, and other parameters that have historically predicted the timing of delta/longfin smelt migration into the Delta. On an ongoing basis, and consistent with the parameters outlined below and in Attachment B, the SWG shall recommend to the USFWS OMR flows that are expected to minimize entrainment of adult delta/longfin smelt. Throughout the implementation of RPA Component 1, the USFWS and DFG will make the final determination as to OMR flows required to protect delta/longfin smelt.

OMR flow requirements given below are based on the following understanding: Where a 14-day running average is established, the average daily OMR flow must be no more negative than the required OMR flow. Where a 5-day running average is given, the daily average shall be no more than 25 percent more negative than the requirement. The daily OMR flows used to compute both the 14-day and the 5-day averages shall be the “tidally filtered” values reported by USGS.

Low-entrainment risk period: delta/longfin smelt salvage has historically been low between December 1 and December 19, even during periods when first flush conditions (i.e., elevated river inflow and turbidity) occurred. During the low-entrainment risk period, the SWG shall determine if the information generated by physical (i.e. turbidity and river inflow) and biological (e.g., salvage, DFG trawls) monitoring indicates that delta/longfin smelt are vulnerable to entrainment or are likely to migrate into a region where future entrainment events may occur. If this occurs, USFWS or DFG shall require initiation of Action 1 as described in Attachment B. Action 1 shall require the Projects to maintain OMR flows no more negative than -2,000 cfs (14-day average) with a simultaneous 5-day running average flow no more negative than -2,500 cfs to protect adult delta/longfin smelt for 14 days.

High-entrainment risk period: delta/longfin smelt have historically been entrained when first flush conditions occur in late December. In order to prevent or minimize such entrainment, Action 1 shall be initiated on or after December 20 if the three day average turbidity at Prisoner’s Point, Holland Cut, and Victoria Canal exceeds 12 NTU, or if there are three days of delta/longfin smelt salvage at either facility or if the cumulative daily salvage count is above the risk threshold based upon the “daily salvage index” approach described in Attachment B. Action 1 shall require the Projects to maintain OMR flows no more negative than -2,000 cfs (14-day running average) with a simultaneous 5-day running average flow no more negative than -2,500 cfs to protect adult delta/longfin smelt for 14 days. However, the SWG can recommend a delayed start or interruption based on other conditions such as delta inflow that may affect vulnerability to entrainment.

Winter protection period: recent analyses indicate that cumulative adult entrainment and salvage are lower when OMR flows are no more negative than -5,000 cfs in the December through March period. Action 2 shall commence immediately after Action 1 ends. If Action 1 is not implemented, the SWG may recommend a start date for the implementation of Action 2 to protect adult delta/longfin smelt. OMR flows under Action 2 shall be in the range of -3,500 to -5,000 when turbidity and salvage are low. Based on historic conditions, OMR flow would generally be expected to be in the range of -2,000 cfs to -3,500 cfs given recent salvage events. However, at times when turbidity and flow conditions in the Delta may result in increased salvage, the range may be between -1,250 to -2,000 cfs. During the implementation of the action, the maximum negative flow for OMR shall be determined based on the criteria outlined in Attachment B. The OMR flow shall be based on a 14-day running average with simultaneous 5-day running average within 25 percent of the required OMR flow. The action may be suspended temporarily if the three day flow average is greater than or equal to 90,000 cfs at the Sacramento River at Rio Vista and 10,000 cfs at the San Joaquin River at Vernalis, because there is low likelihood that delta/longfin smelt will be entrained during such high inflow conditions. Suspension of this action due to high flow will end when flow drops below the 90,000 cfs and 10,000 cfs threshold. Action 2 ends when spawning begins as defined for Action 3 implementation (Component 2).

RPA Component 2: Protection of Larval and Juvenile Delta and Longfin Smelt

Delta and longfin smelt larvae and juveniles are susceptible to direct mortality by entrainment. Hydrologic conditions resulting from CVP/SWP operations increase the risk of that entrainment. The objective of this RPA component (which corresponds to Action 3 in Attachment B), is to improve flow conditions in the Central and South Delta so that larval and juvenile delta/longfin smelt can successfully rear in the Central Delta and move downstream when appropriate.

Upon completion of RPA Component 1 or when Delta water temperatures reach 12˚C (based on a three-station average of daily average water temperature at Mossdale, Antioch, and Rio Vista) or when a spent female delta/longfin smelt is detected in the trawls or at the salvage facilities, the projects shall operate to maintain OMR flows no more negative than -1,250 to -5000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25 percent of the applicable 14-day OMR flow requirement. Depending on the extant conditions, the SWG shall make recommendations for the specific OMR flows within this range from the onset of implementing RPA Component 2 through its termination. USFWS and DFG shall make the final determination regarding specific OMR flows. This action shall end June 30 or when the 3-day mean water temperature at CCF reaches 25° C, whichever occurs earlier.

The Spring Head of Old River Barrier (HORB) shall be installed only if USFWS determines delta/longfin smelt entrainment is not a concern (Action 5 from Attachment B).

RPA Component 5: Monitoring and Reporting

Reclamation and DWR shall ensure that information is gathered and reported to ensure that:

1) These actions are proper implemented,
2) The physical results of these actions are achieved, and
3) Information is gathered to evaluate the effectiveness of these actions on the targeted life stages of delta/longfin smelt so that the actions can be refined, if needed.

Essential information to evaluate these actions (and the Incidental Take Statement) includes sampling of the Fall Midwater Trawl (FMWT), Spring Kodiak Trawl, 20-mm Survey, Summer Townet Survey (TNS) and the Environmental Monitoring Program of the Interagency Ecological Program (IEP). This information shall be provided to USFWS and DFG within 14 days of collection. Additional monitoring and research will likely be required, as defined by the adaptive management process.

Information on salvage at Banks and Jones is both an essential trigger for some of these actions and an important performance measure of their effectiveness. In addition, information on OMR flows and concurrent measures of delta/longfin smelt distribution and salvage are essential to ensure that actions are implemented effectively. Such information shall be included in an annual report for the WY (October 1 to September 30) to USFWS and DFG, provided no later than October 15 of each year, starting in 2010.

DWR shall implement these actions based on performance standards, monitoring and evaluation of results from the actions undertaken. Some of the data needed for these performance measures are already being collected such as the FMWT abundances and salvage patterns. However, more information on the effect of these actions on smelt survival and the interactions of project operations with other stressors on delta/longfin smelt health, fecundity and survival is needed. This information may provide justification for refining these actions to better address the needs of delta/longfin smelt. Studies like those of the IEP's POD workteam have provided much useful information on the needs of delta/longfin smelt and the stressors affecting them that was integral in the development of these actions.

Delta and Longfin Smelt Risk Assessment Matrix (SRAM)

The SWG will employ delta and longfin smelt risk assessment matrices to assist in evaluating the need for operational modifications of SWP and CVP to protect delta/longfin smelt. The currently approved DSRAM is Attachment A of the 2008 USFWS BO. These documents will be tools of the SWG and will be modified by the SWG with the approval of USFWS and DFG, in consultation with DWR as new knowledge becomes available. If an action is taken, the SWG will follow up on the action to attempt to ascertain its effectiveness. The ultimate decision-making authority rests with USFWS and DFG for longfin smelt. An assessment of effectiveness will be attached to the notes from the SWG's discussion concerning the action.

REAL TIME FLOW PRESCRIPTIONS

The following actions will be implemented for the protection of longfin smelt as determined per the process described above (as modified from the 2008 USFWS BO Attachment B).

ACTION 1: ADULT MIGRATION AND ENTRAINMENT (FIRST FLUSH)

Objective: A fixed duration action to protect pre-spawning adult delta/longfin smelt from entrainment during the first flush, and to provide advantageous hydrodynamic conditions early in the migration period.

Action: Limit exports so that the average OMR flow[1] is no more negative than - 2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,400 cfs (within 20%).

Timing: Part A: December 1 to December 20 – Based upon an examination of turbidity data from Prisoner's Point, Holland Cut, and Victoria Canal and salvage data from CVP/SWP (see below), and other parameters important to the protection of delta/longfin smelt including, but not limited to, preceding conditions of X2, FMWT, and river flows; the SWG may recommend a start date to USFWS. USFWS and DFG will make the final determination.

Part B: After December 20 – The action will begin if the three day average turbidity at Prisoner's Point, Holland Cut, and Victoria Canal exceeds 12 NTU. However the SWG can recommend a delayed start or interruption based on the turbidity three day average not being met, or variation in other conditions such as delta inflow that may affect vulnerability to entrainment.

Triggers (Part B):

> <u>*Turbidity:*</u> Three-day average of 12 NTU or greater at *all three* stations (Prisoner's Point, Holland Cut, and Victoria Canal)
>
> *OR*
>
> <u>*Salvage:*</u> Three days of delta/longfin smelt salvage at either facility or cumulative daily salvage count that is above a risk threshold based upon the "daily salvage index" approach reflected in a daily salvage index value ≥0.5 (daily delta/longfin smelt salvage > one-half prior year FMWT index value).

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[1] OMR Flows for this and all relevant actions will be measured at the Old River at Bacon Island and Middle River at Middle River stations, as has been established already by the Interim Order.

The window for triggering Action 1 concludes when either off ramp condition described below is met. These off ramp conditions may occur without Action 1 ever being triggered. If this occurs, then Action 3 is triggered[2], unless USFWS and DFG conclude on the basis of the totality of available information that Action 2 should be implemented instead.

Off-ramps:

Temperature: Water temperature reaches 12^{o}C based on a three station daily mean at Mossdale, Antioch, and Rio Vista

OR

Biological: Onset of spawning (presence of spent females in SKT or at Banks or Jones).

ACTION 2: ADULT MIGRATION AND ENTRAINMENT

Objective: An action implemented using adaptive management to tailor protection to changing environmental conditions after Action 1. As in Action 1, the intent is to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions.

Action: The range of OMR flows will be no more negative than -1,250 to -5,000 cfs. Depending on extant conditions (and the general guidelines below) specific OMR flows within this range are recommended by the SWG from the onset of Action 2 through its termination.
The SWG would provide weekly recommendations based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. USFWS and DFG will make the final determination.

Timing: Beginning immediately after Action 1. Before this date (in time for operators to implement the flow requirement) the SWG will recommend specific requirement OMR flows based on salvage and on physical and biological data on an ongoing basis.

Suspension of Action:

Flow: OMR targets do not apply whenever a three day flow average is greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and 10,000 cfs in San Joaquin River at Vernalis. Once such flows have abated, the OMR flow requirements of the Action are again in place.

Off-ramps:

Temperature: Water temperature reaches 12°C based on a three station daily average (Rio Vista, Antioch, Mossdale)

OR

Biological: Onset of spawning (presence of spent females in SKT or at either facility)

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[2] The off ramp criteria for Actions 1 and 2 to protect adults from entrainment are identical to the initiation triggers for Action 3 to protect larval/juveniles from entrainment

Adaptive Management Required Parameters:

Two scenarios span the range of circumstances likely to exist during Action 2. First, the low-entrainment risk scenario. There may be a low risk of adult entrainment because (a) there has been no discernable migration of adults into the South and Central Delta; or (b) the upstream migration has already occurred but turbidity is low and there is no or little evidence of ongoing adult entrainment. In this scenario, higher negative OMR flow rates as high as -5,000 cfs may be ventured as long as entrainment risk factors and salvage permit.

The second scenario, the high-entrainment risk scenario, is one in which either (a) there is evidence that upstream adult migration is currently occurring; or (b) upstream migration has already occurred and there are adult fish in the South and Central Delta and turbidity is high, increasing the risk of entrainment; or (c) there is evidence of ongoing entrainment, regardless of other risk factors. In this case, OMR will be set to reduce entrainment and/or the risk of entrainment as the totality of circumstances warrant.

Generally, if the available distributional information suggests that most delta/longfin smelt are in the North or North/Central Delta, then OMR can be chosen to minimize Central Delta entrainment. However, if the distributional information suggests there are delta/longfin smelt in the Central or South Delta, then OMR will have to be set lower to reduce entrainment of delta/longfin smelt.

The following describes how these action guidelines would be implemented at the start of Action 2 and at other times during Action 2.

1. OMR setting at initiation of Action 2

a) If salvage is zero during the final 7 days of Action 1, and three station mean turbidity is below 15 NTU, then increase negative OMR to no more negative than -5,000 cfs on a 14-day running average with a simultaneous 5-day running average within 20% of the applicable target OMR[3];

UNLESS

b) If salvage is less in the most recent three days than in the preceding three days of Action 1, and the maximum Daily Salvage Index is ≤1 during the prior 7 days, then limit exports to achieve OMR flows no more negative than -3,500 cfs on a 14-day running average for 7 more days (or until 4 consecutive days of zero salvage or any 5 of 7 days with zero salvage), with a 5-day running average within 20 percent of the applicable requirement OMR;

OR

c) If salvage is greater or equal in the last three days than in the preceding three days of Action 1, and maximum Daily Salvage Index ≥1 during any of those days, then continue OMR flow at no more negative than -2,000 cfs on a 14-day running average for an additional 14 days (or until

[3] The 5-day running average is calculated from actual daily OMR values, not from averaged OMR values computed using the seven day running average described previously.

4 succeeding days of zero salvage or any 5 of 7 days zero salvage), with a simultaneous 5-day running average within 20 percent of the applicable requirement OMR;

OR

d) If circumstances existing at the initiation of Action 2 are, in the judgment of USFWS, markedly different from those anticipated in (a) through (c) above, then the OMR flow requirement in (c) will be applied and the SWG will review available data and recommend an initial flow rate to USFWS and DFG.

2. OMR setting after initiation of Action 2

a) The SWG will review all available information and request updated entrainment simulations and/or other information, as needed, on a weekly basis to decide whether the current OMR requirement is appropriate or should be changed.

b) Unless OMR is grossly positive regardless of water project operations, due to high Delta tributary river discharges, then important variables that affect the risk of adult entrainment during Action 2 include (1) salvage or other actual entrainment indicators, (2) turbidity, (3) available monitoring results, hydrologic variables other than export pumping rates that affect OMR flow, (4) apparent population size from the preceding FMWT survey, (5) particle tracking or other model-based entrainment risk information.

c) As described above, the risk of entrainment is generally higher when there is evidence of ongoing entrainment or turbidity is high, and these two variables are the most likely triggers of decisions to raise or lower OMR flow requirements.

d) Based on historical experience, OMR flow requirements between the limits of -2,000 cfs and -5,000 cfs is likely to be adequate in most years. The exception is a year in which there appears, for whatever reasons, to be a substantial fraction of the adult spawning migrant population in the Central and/or South Delta. When this occurs, more stringent OMR limitation (possibly to no more negative than - 1,250 cfs) may be required.

ACTION 3: ENTRAINMENT PROTECTION OF LARVAL SMELT

Objective: Minimize the number of larval delta/longfin smelt entrained at the facilities using VAMP-like flow levels and export reductions spanning a time sufficient for protection of larval delta/longfin smelt. Because protective OMR flow requirements vary over time (especially between years), the action is adaptive and flexible within appropriate constraints.

Action: OMR will be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average within 20 percent of the applicable requirement OMR.[4] Depending on extant conditions (and the general guidelines below) specific OMR flows within this range are recommended by the SWG from the onset of Action 2 through its termination (see Adaptive Management Process).[5] The SWG would provide these

[4] The 5-day running average is calculated from actual daily OMR values, not from averaged OMR values computed using the seven day running average described previously.

.

[5] During most conditions, it is expected that maximum negative OMR flows will range between -2000 and

recommendations based upon weekly review of sampling data, from real-time salvage data at the CVP/SWP, and expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. USFWS and DFG will make the final determination.

Timing: Initiate the action twenty days after reaching the triggers below, which are indicative of spawning activity and the probable presence of larval delta/longfin smelt in the South and Central delta. During the twenty days between the end of actions 1 and/or 2 and all intervening days thereafter, OMR flow will be set at no more negative than -5,000 cfs on a 14-day running average with a five-day running average (computed from actual daily OMR values) not more negative than the requirement by more than twenty percent. Based upon daily salvage data, the SWG may recommend an earlier start to Action 3. USFWS and DFG will make the final determination.

Triggers:

Temperature: When temperature reaches 12°C based on a three station average at Mossdale, Antioch, and Rio Vista.

OR

Biological: Onset of spawning (presence of spent females in SKT or at either facility).

Offramps:

Temporal: June 30;

OR

Temperature: Water temperature reaches a daily average of 25°C for three consecutive days at CCF.

Adaptive Management Required Parameters:

During the larval/juvenile entrainment risk period, the SWG will meet weekly to review available physical and biological data and develop a recommendation to USFWS. USFWS and DFG will determine the specific OMR requirement based upon the SWG recommendation and the strength of the accompanying scientific justification.

Two scenarios span the range of circumstances likely to exist during Action 3. First, the low-entrainment risk scenario. There may be a low risk of larval/juvenile entrainment because there has been no evidence of delta/longfin smelt in the South and Central Delta. In this scenario, negative OMR flow rates as high as -5,000 cfs may occur as long as entrainment risk factors permit.

The second scenario, the high-entrainment risk scenario, is one in which either: a) there is evidence of delta/longfin smelt in the South and Central Delta from the SKT and/or 20mm survey; or (b) there is evidence of ongoing entrainment, regardless of other risk factors. In this case, OMR should be set to reduce entrainment and/or the risk of entrainment as the totality of circumstances warrant.

-3500. During certain years of higher or lower predicted entrainment risk, requirements as low as - 1,250 or -5,000 will be recommended to USFWS by the SWG

Usually, if the available distributional information suggests that most delta/longfin smelt are in the North or North/Central Delta, then OMR can be chosen to minimize Central Delta entrainment. However, if the distributional information suggests there are delta/longfin smelt in the Central or South Delta, then OMR will have to be set lower to reduce entrainment of these fish. If delta/longfin smelt abundance is low, distribution cannot be reliably inferred. Therefore, the adaptive management process is extremely important. The SWG may recommend any specific running average OMR requirement within the specified range above.

ACTION 5: TEMPORARY SPRING HEAD OF OLD RIVER BARRIER (HORB) AND THE TEMPORARY BARRIER PROJECT (TBP)

Objective: To minimize entrainment of larval and juvenile delta/longfin smelt at Banks and Jones or from being transported into the South and Central Delta, where they could later become entrained.

Action: Do not install the HORB if delta/longfin smelt entrainment is a concern. If installation of the HORB is not allowed, the agricultural barriers would be installed as described above. If installation of the HORB is allowed, the TBP flap gates would be tied in the open position until May 15.

Timing: The timing of the action would vary depending on the conditions. The normal installation of the spring temporary HORB and the TBP is in April.

Triggers: For delta/longfin smelt, installation of the HORB will only occur when PTM results show that entrainment levels of delta/longfin smelt will not increase beyond 1 percent at Station 815 as a result of installing the HORB.

Offramps: If Action 3 ends or May 15, whichever comes first.

DWR shall ensure that information is gathered and reported to ensure that: (1) proper implementation of these actions; (2) the physical results of these actions are achieved; and (3) information is gathered to evaluate the effectiveness of these actions on the targeted life stages of delta/longfin smelt so that the actions can be refined, if needed. Essential information to evaluate these actions (and the Incidental take Statement) includes sampling of the FMWT, the 20-mm Survey and the Environmental Monitoring Program of the IEP. This information shall be provided to USFWS and DFG within 14 days of collection.

Information on salvage at both facilities is both an essential trigger for some of these actions and an important performance measure of their effectiveness. In addition, information on OMR flows and concurrent measures of delta/longfin smelt distribution and salvage are essential to ensure that actions are implemented effectively. Such information shall be included in an annual report to USFWS and DFG.

DWR shall implement these action based on performance standards, monitoring and evaluation of results from the actions undertaken and adaptive management as described in RPA component 3. RPA component 3 has a robust adaptive management component that is a separate analysis than this component. Some of the data needed for these performance measures are already being collected such as the FMWT abundances and salvage patterns. However, more information on the effect of these actions on smelt survival and the interactions of project operations with other stressors on delta/longfin smelt health, fecundity and survival is needed to refine these actions to better address the needs of delta/longfin smelt. Studies like those of the IEP's POD workteam have provided much useful information on the needs of delta/longfin smelt and the stressors affecting them that was integral in the development of these actions.

CHAPTER 3
ENVIRONMENTAL CHECKLIST

PROJECT INFORMATION

1.	Project Title:	On-going California State Water Project Operations in the Sacramento-San Joaquin Delta for the Protection of Longfin Smelt
2.	Lead Agency Name & Address:	California Department of Water Resources 3500 Industrial Boulevard West Sacramento, California 95691
3.	Contact Person & Phone Number:	Heidi Rooks, Chief of Ecological Studies Branch, Division of Environmental Services; (916) 376-9704
4.	Project Location:	Sacramento-San Joaquin Delta
5.	Responsible Agency Name & Address:	California Department of Fish and Game 1416 Ninth Street Sacramento, California 95814
6.	Zoning:	Various
7	Description of Project:	Refer to Chapter 2 of this document
8.	Surrounding Land Uses & Setting:	Refer to Chapter 3 of this document (Section IX, Land Use Planning)

9. Approval Required from Other Public Agencies: California Department of Fish and Game

1. ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact", as indicated by the checklist on the following pages.

☐ Aesthetics	☐ Agricultural Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☐ Geology/Soils
☐ Hazards & Hazardous Materials	☐ Hydrology/Water Quality	☐ Land Use/Planning
☐ Mineral Resources	☐ Noise	☐ Population/Housing
☐ Public Services	☐ Recreation	☐ Transportation/Traffic
☐ Utilities/Service Systems	☐ Mandatory Findings of Significance	☒ None

DETERMINATION

On the basis of this initial evaluation:

I find that the proposed project COULD NOT have a significant effect on the environment and a NEGATIVE DECLARATION will be prepared. ☒

I find that, although the original scope of the proposed project COULD have had a significant effect on the environment, there WILL NOT be a significant effect because revisions/mitigations to the project have been made by or agreed to by the applicant. A MITIGATED NEGATIVE DECLARATION will be prepared. ☐

I find that the proposed project MAY have a significant effect on the environment and an ENVIRONMENTAL IMPACT REPORT or its functional equivalent will be prepared. ☐

I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated impact" on the environment. However, at least one impact has been adequately analyzed in an earlier document, pursuant to applicable legal standards, and has been addressed by mitigation measures based on the earlier analysis, as described in the report's attachments. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the impacts not sufficiently addressed in previous documents. ☐

I find that, although the proposed project could have had a significant effect on the environment, because all potentially significant effects have been adequately analyzed in an earlier EIR or Negative Declaration, pursuant to applicable standards, and have been avoided or mitigated, pursuant to an earlier EIR, including revisions or mitigation measures that are imposed upon the proposed project, all impacts have been avoided or mitigated to a less-than-significant level and no further action is required. ☐

Barbara McDonnell — Jan 12, 2009

Barbara McDonnell
Chief, Environmental Services

Date

Evaluation of Environmental Impacts

1. A brief explanation is required for all answers, except "No Impact", that are adequately supported by the information sources cited. A "No Impact" answer is adequately supported if the referenced information sources show that the impact does not apply to the project being evaluated (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on general or project-specific factors (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2. All answers must consider the whole of the project-related effects, both direct and indirect, including off-site, cumulative, construction, and operational impacts.

3. Once the lead agency has determined that a particular physical impact may occur, the checklist answers must indicate whether that impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate when there is sufficient evidence that a substantial or potentially substantial adverse change may occur in any of the physical conditions within the area affected by the project that cannot be mitigated below a level of significance. If there are one or more "Potentially Significant Impact" entries, an Environmental Impact Report (EIR) is required.

4. A "Mitigated Negative Declaration" (Negative Declaration: Less Than Significant with Mitigation Incorporated) applies where the incorporation of mitigation measures, prior to declaration of project approval, has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact with Mitigation." The lead agency must describe the mitigation measures and briefly explain how they reduce the effect to a less than significant level.

5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR (including a General Plan) or Negative Declaration [CCR, Guidelines for the Implementation of CEQA, § 15063(c)(3)(D)]. References to an earlier analysis should:

   a) Identify the earlier analysis and state where it is available for review.

   b) Indicate which effects from the environmental checklist were adequately analyzed in the earlier document, pursuant to applicable legal standards, and whether these effects were adequately addressed by mitigation measures included in that analysis.

   c) Describe the mitigation measures in this document that were incorporated or refined from the earlier document and indicate to what extent they address site-specific conditions for this project.

6. Lead agencies are encouraged to incorporate references to information sources for potential impacts into the checklist or appendix (e.g., general plans, zoning ordinances, biological assessments). Reference to a previously prepared or outside document should include an indication of the page or pages where the statement is substantiated.

7. A source list should be appended to this document. Sources used or individuals contacted should be listed in the source list and cited in the discussion.

8. Explanation(s) of each issue should identify:
   a) the criteria or threshold, if any, used to evaluate the significance of the impact addressed by each question **and**
   b) the mitigation measures, if any, prescribed to reduce the impact below the level of significance.

ENVIRONMENTAL ISSUES

I. AESTHETICS

ENVIRONMENTAL SETTING

The visual resources of the Delta are characterized by agriculture and multiple state recreation areas, including Franks Tract, Brannon Island, and Windy Cove; Stone Lakes National Wildlife Refuge; the Cosumnes-Mokelumne River confluence wildlife preserve; and several private marinas, camping, and fishing sites. Delta waterways, including rivers, creeks, and sloughs, are visible primarily from boats which use the Delta for commerce and recreation. State Route 160 is a state-designated scenic highway from Antioch to Freeport. Additionally, views from the Delta include Mount Diablo in Contra Costa County and the Vaca Range in Napa and Solano counties.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

DISCUSSION

a-d) The proposed project does not include any construction, modification of landforms, or changes in water operations or facilities. Therefore, the proposed project would not result in any impacts upon any scenic vista, damage to any scenic resource including trees, rock outcroppings or historic buildings within a state scenic highway, or create a new source of light or glare that would adversely affect day or nighttime views in the project study area. Therefore, the proposed project would not result in any impacts to aesthetics.

II. AGRICULTURAL RESOURCES

ENVIRONMENTAL SETTING

California is one of the most diversified agricultural economies in the world, producing more than 400 crop and livestock commodities. California's 75,000 farms and ranches received a record $36.6 billion for their output in 2007. California was the number one state in cash farm receipts in 2007, with its $36.6 billion in revenue representing 12.8 percent of the United States total (USDA 2008).

California's agricultural abundance includes more than 400 commodities. The state produces about half of U.S.-grown fruits, nuts, and vegetables. Many crops are produced exclusively in California. California is the sole producer (99 percent or more) of the following commodities: almonds, artichokes, figs, raisins (grapes), olives, clingstone peaches, persimmons, dried plums, pomegranates, sweet rice, Ladino clover seed, and walnuts (USDA 2008).

Today, of the nearly 750,000 acres in the Delta, about 641,000 acres are rich farmland. Most of this area is classified as prime farmland, farmland of statewide importance, and unique farmland, or land with high statewide significance for agricultural production. The Delta's rich peat and mineral soils support several types of agriculture.

The Delta includes San Joaquin, Yolo, Solano, Sacramento and Contra Costa counties. According to total value of agricultural production, San Joaquin County was ranked 7th out of 58 counties in California, with milk, grapes, cherries, almonds, and walnuts as the leading commodities. Yolo County was ranked as the number 23 agricultural producing county with leading commodities of tomatoes, alfalfa hay, wine grapes, rice, and seed crops. Sacramento County was ranked number 25, with leading commodities of wine grapes, milk, nursery stock, vegetables, and poultry. Solano County was ranked 27th in the state with nursery products, alfalfa, tomatoes, cattle and calves, and walnuts as top commodities. Contra Costa County was ranked 39th, with leading commodities of sweet corn, cattle and calves, bedding plants, grapes, and tomatoes (USDA 2008)

WOULD THE PROJECT*:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland to non-agricultural use?	☐	☐	☐	☒

* In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997), prepared by the California Department of Conservation as an optional model for use in assessing impacts on agricultural and farmland.

DISCUSSION

a-c) The proposed project does not include any new construction of water facilities, infrastructure, or other type of construction or land disturbance and, would not involve any changes to land use designations or zoning. No changes to water distribution would occur that would change the pattern of irrigation for agricultural uses. The proposed project would not directly or indirectly result in the conversion of land areas classified as important farmland, zoned for agricultural use, or under a Williamson Act contract, to non-agricultural use. Thus, there would be no impact to agricultural resources as a result of the project.

III. AIR QUALITY

ENVIRONMENTAL SETTING

The topography of the Delta is characterized by two distinct geographic components: the lowlands and the uplands. The lowlands consist of generally flat lands ranging in elevation from below sea level to about 10 feet above mean sea level (msl). The uplands are gently sloping alluvial plains rising from about 10 to 100 feet above msl. The effects of the local topography and the continuous interaction of maritime and continental air masses provide a varied climate.

The topography and climate of the Delta have a large effect on the area's air quality. Relatively light winds, surrounding higher terrain, and frequent warm temperatures are conducive to the creation of ozone. In winter months, high atmospheric stability, calm winds, and cold temperatures combine to create ideal conditions for the buildup of pollutants such as carbon monoxide and particulate matter.

The Delta is located within portions of both the Sacramento Valley and San Joaquin Valley air basins. Air quality in the project area is regulated by both federal and state jurisdictions including the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (CARB). CARB regulates air quality in California through local Air Pollution Control Districts (APCD) and Air Quality Management Districts (AQMD).

Air quality in these two air basins occasionally fails to meet State standards. The San Joaquin Valley Air Basin has one of the most severe ozone air pollution problems in the State; both periodically endure non-attainment conditions for ozone and particulate matter (PM_{10}).

WOULD THE PROJECT*:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Conflict with or obstruct implementation of the applicable air quality plan or regulation?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations (e.g., children, the elderly, individuals with compromised respiratory or immune systems)?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒

* Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make these determinations.

DISCUSSION

a – e) Implementation of the proposed project would not conflict with or obstruct implementation of applicable air quality plans, violate any air quality standards, result in cumulative net increases of criteria pollutants, expose sensitive receptors to substantial pollutant concentrations, or create objectionable odors. Because the proposed project does not involve any construction activities, changed operations resulting in emissions, or changes in land uses that would indirectly change emissions, there would be no impact to air quality.

IV. BIOLOGICAL RESOURCES

FISHERIES AND AQUATIC RESOURCES ENVIRONMENTAL SETTING

San Francisco Bay (Bay) and the Delta make up the largest estuary on the west coast (EPA 1992). The Delta, the most upstream portion of the Bay-Delta, is a triangle-shaped area composed of islands, river channels, and sloughs at the confluence of the Sacramento and San Joaquin rivers.

Presented below is a general description of the Bay-Delta Estuary; including the principal hydraulic features of the Sacramento and San Joaquin rivers and the Delta that affect aquatic resources, and descriptions of the status, life history, and factors affecting abundances of selected fish and invertebrate species. The following descriptions of the aquatic habitats and fish populations within the Delta utilize information obtained from the Interim South Delta Program (ISDP) Draft EIS/EIR (DWR and Reclamation 1996a), the Lower Yuba River Accord Draft EIR/EIS (YCWA et al. 2007) and the 2008 OCAP BA (Reclamation 2008).

The Delta's tidally influenced channels and sloughs cover a surface area of approximately 75 square miles. These waters support a number of resident freshwater fish and invertebrate species. Marsh plains and tidal channels formed within these intertidal regions continuously drain and fill with the ocean tide allowing movement of fishes, in addition to primary and secondary production, inshore and offshore. Tidal action may therefore be important for pelagic organisms as inundation allows increased foraging success and opportunity resulting from the larger abundance of phytoplankton and zooplankton inshore. Intertidal habitats may also provide reduced predation for young fishes (Brown 2003). These waters may also be used as migration corridors and rearing areas for anadromous fish species and as spawning and rearing grounds for many estuarine species. Shallow-water habitats, defined as waters less than three meters in depth (mean low water), are considered particularly important forage, reproduction, rearing, and refuge areas for numerous fish and invertebrate species.

The Bay-Delta Estuary provides habitat for a diverse assemblage of fish and macroinvertebrates. Many of the fish and macroinvertebrate species inhabit the estuary year-round, while other species inhabit the system on a seasonal basis as a migratory corridor between upstream freshwater riverine habitat and coastal marine waters, as seasonal foraging habitat, or for reproduction and juvenile rearing. There have been more than 100 documented introductions of exotic species to the Bay-Delta Estuary. These include intentionally introduced game fish such as striped bass and American shad, as well as inadvertent introductions of undesirable organisms such as the Asiatic clams. **Table 3-1** lists common and scientific names for known native and exotic fish species found in the Delta.

Migratory (e.g., anadromous) fish species inhabiting the Bay-Delta and its tributaries include, but are not limited to, white sturgeon, green sturgeon, Chinook salmon (including fall-run, spring-run, winter-run, and late-fall-run), steelhead, American shad, Pacific lamprey, and river lamprey (Moyle 2002). The Bay-Delta and tributaries also support a diverse community of resident fish that includes, but is not limited to, Sacramento sucker, prickly and riffle sculpin, California roach, hardhead, hitch, Sacramento blackfish, Sacramento pikeminnow, speckled dace, Sacramento splittail, tule perch, inland silverside, black crappie, bluegill, green sunfish, largemouth bass, smallmouth bass, white crappie, threadfin shad, carp, golden shiner, black and brown bullhead, channel catfish, white catfish, and a variety of other species that inhabit the more estuarine and freshwater portions of the Bay-Delta system (Moyle 2002).

Table 3-1. Fishes of the Sacramento-San Joaquin Delta

Common Name	Scientific Name	Life History	Status
Pacific lamprey*	*Lampetra tridentata*	A	Declining
River lamprey*	*Lampetra ayresi*	A	CSC
White sturgeon*	*Acipenser transmontanus*	A	Declining
Green sturgeon*	*Acipenser medirostris*	A	FT, CSC
American shad	*Alosa sapidissima*	A	Non-native
Threadfin shad	*Dorosoma petenense*	A	Common
Steelhead*	*Oncorhynchus mykiss*	A	FT
Brown trout	*Salmo trutta*	R	Non-native
Chum salmon*	*Oncorhynchus keta*	A	CSC; rare
Chinook salmon* fall-run late fall-run winter-run spring-run	*Oncorhynchus tshawytscha*	A	 SC, CSC SC, CSC FE, SE FT, ST
Longfin smelt*	*Spirinchus thaleichthys*	A-R	FP, SP
Delta smelt*	*Hypomesus transpacificus*	R	FT, ST
Wakasagi	*Hypomesus nipponensis*	N	Invading
Hitch*	*Lavinia exilicauda*	R	Unknown
Sacramento blackfish*	*Orthodon microlepidotus*	R	Unknown
Sacramento splittail*	*Pogonichthys macrolepidotus*	R	CSC
Hardhead*	*Mylopharodon conocephalus*	N	CSC
Speckled dace	*Rhinichthys osculus*	R	CSC
California roach	*Lavinia symmetricus*	R	CSC
Sacramento pikeminnow*	*Ptychocheilus grandis*	R	Common
Fathead minnow	*Pimephales promelas*	N	Rare
Golden shiner	*Notemigonus crysoleucas*	N	Invading
Common carp	*Cyprinus carpio*	R	Common
Goldfish	*Carassius auratus*	R	Uncommon
Sacramento sucker*	*Catostomus occidentalis*	R	Common
Black bullhead	*Ameiurus melas*	R	Common
Brown bullhead	*Ameiurus nebulosus*	R	Uncommon
White catfish	*Ameiurus catus*	R	Abundant
Channel catfish	*Ictalurus punctatus*	R	Common
Western mosquitofish	*Gambusia affinis*	R	Abundant
Striped bass	*Morone saxatilis*	R-A	Declining
Inland silverside	*Menidia beryllina*	R	Abundant
Sacramento perch*	*Archoplites interruptus*	N	CSC
Bluegill	*Lepomis macrochirus*	R	Common
Redear sunfish	*Lepomis microlophus*	R	Uncommon
Green sunfish	*Lepomis cyanellus*	R	Uncommon
Warmouth	*Lepomis gulosus*	R	Uncommon
White crappie	*Pomoxis annularis*	R	Common
Black crappie	*Pomoxis nigromaculatus*	R	Uncommon
Largemouth bass	*Micropterus salmoides*	R	Common
Smallmouth bass	*Micropterus dolomieu*	R	Uncommon
Redeye bass	*Micropterus coosae*	R	Non-native
Spotted bass	*Micropterus punctulatus*	R	Non-native
Bigscale logperch	*Percina macrolepida*	R	Common
Yellow perch	*Perca flavescens*	N	Rare
Tule perch*	*Hysterocarpus traski*	R	Common
Threespine stickleback*	*Gasterosteus aculeatus*	R	Common
Yellowfin goby	*Acanthogobius flavimanus*	R	Common

Common Name	Scientific Name	Life History	Status
Chameleon goby	*Tridentiger trigonocephalus*	R	Invading
Staghorn sculpin*	*Leptocottus armatus*	M	Common
Prickly sculpin*	*Cottus asper*	R	Abundant
Starry flounder*	*Platichthys stellatus*	M	Common

Source: Modified from USFWS 1994, as cited in DWR and Reclamation 1996
Note: An asterisk (*) indicates a native species
Key:

A = anadromous	FT = Federal threatened	CSC = State species of special concern
FC = Federal candidate	M = marine	SE = State endangered
FE = Federal endangered	N = non-resident visitor	ST = State threatened
FP = Federal proposed	R = resident	SC = Federal species of concern
SP = State proposed		

The geographic distribution of species within the estuary is determined, in part, by salinity gradients, which range from freshwater within the Sacramento and San Joaquin river system to marine conditions near the Golden Gate Bridge. The abundance, distribution, and habitat use by these fish and macroinvertebrates has been monitored over a number of years through investigations conducted by DFG, NMFS, USFWS, Reclamation, and several other investigators. Results of these monitoring programs have shown changes in species composition and abundance within the system over the past several decades. Many of the fish and macroinvertebrate species have experienced generally declining trends in abundance (Moyle et al. 1995) with several native species, including winter-run and spring-run Chinook salmon, steelhead, delta smelt and longfin smelt either listed or being considered for listing under the Federal ESA or CESA.

Many factors have contributed to the decline of fish species within the Delta (Moyle et al. 1995), including changes in hydrologic patterns resulting from water project operations, loss of habitat, contaminant input, entrainment in diversions, and introduction of non-native species. The Delta is a network of channels through which water, nutrients, and aquatic food resources are moved and mixed by tidal action. Pumps and siphons divert water for Delta irrigation and municipal and industrial use or into CVP and SWP canals. River inflow, DCC operations, and diversions (including agricultural and municipal diversions and export pumping) affect Delta species through changes in habitat conditions (e.g., salinity intrusion), and mortality attributable to entrainment in diversions.

Seasonal and interannual variability in hydrologic conditions, including the magnitude of flows into the Bay-Delta Estuary from the Sacramento and San Joaquin rivers and other tributaries and the outflow from the Delta into San Francisco Bay, have been identified as important factors affecting habitat quality and availability, and abundance for a number of fish and invertebrate species within the Bay-Delta Estuary. Flows within the Bay-Delta system may affect larval and juvenile transport and dispersal, water temperatures (primarily within the upstream tributaries), dissolved oxygen concentrations (e.g., during the fall within the lower San Joaquin River), and salinity gradients within the estuary. The seasonal timing and geographic location of salinity gradients are thought to be important factors affecting habitat quality and availability for a number of species (Baxter et al. 1999). Operation of upstream storage impoundments, in combination with natural hydrologic conditions, affects seasonal patterns in the distribution of salinity within the system. Water project operations, for example, may result in a reduction in Delta inflows during the late winter and spring with an increase in Delta inflows, when compared to historical conditions, during the summer months. Objectives have been established for the location of salinity gradients during the late winter and spring to support estuarine habitat for a number of species, in addition to other salinity criteria for municipal, agricultural, and wetland benefits.

Recent Decline of Pelagic Fish Species in the Delta

In January 2005, DWR and DFG biologists identified and reported a marked decline in pelagic (i.e., open-water) fish species in the Delta. Between 2002 and 2004, the Interagency Ecological Program (IEP) observed record low abundances for delta smelt and striped bass, and near record lows for longfin shad and threadfin shad (IEP 2007). In addition to the declining fish abundance, IEP also observed declining levels of zooplankton.

On December 15, 2008, the USFWS issued a BO on the OCAP to respond to the decline in population of delta smelt. The USFWS concluded that the coordinated operations of the CVP and the SWP are not likely to adversely affect listed species, with the exception of delta smelt. The USFWS concluded that the coordinated operations of the CVP and the SWP, as proposed, were likely to jeopardize the continued existence of the delta smelt, and adversely modify delta smelt critical habitat. Consequently, the USFWS developed RPAs as alternative actions to avoid the likelihood of jeopardizing the continued existence or the destruction or adverse modification of critical habitat for delta smelt. These actions include: (1) preventing/reducing entrainment of delta smelt at Jones and Banks; (2) providing adequate habitat conditions that will allow the adult delta smelt to successfully migrate and spawn in the Bay-Delta; (3) providing adequate habitat conditions that will allow larvae and juvenile delta smelt to rear; and (4) providing suitable habitat conditions that will allow successful recruitment of juvenile delta smelt to adulthood. In addition, USFWS specified that it is essential to monitor delta smelt abundance and distribution through continued sampling programs through the IEP.

TERRESTRIAL RESOURCES ENVIRONMENTAL SETTING

Historically, the Delta supported extensive areas of saline and freshwater emergent marshes. Today, the Delta contains about 641,000 acres of agricultural land (72 percent of the total land area) that dominate its lowland areas. Hundreds of miles of waterways divide the Delta into islands, some of which are below sea level. The Delta has more than 1,000 miles of levees that protect these islands. Much of the freshwater and saline emergent marsh habitat formerly in the Delta has been lost as a result of urban and agricultural development, flood control, and water supply projects; however, some emergent marsh habitat, such as at Suisun Marsh, remain in the Delta. The remaining areas of emergent marsh provide important habitat for many resident and migratory species.

Most of the vegetation in the Delta consists of irrigated agricultural fields and associated ruderal (disturbed), non-native vegetation fringes that border cultivated fields. Throughout much of the Delta, these areas border the levees of various sloughs, channels, and other waterways within the historic floodplain. Native habitats include remnant riparian vegetation that persists in some areas, with brackish and freshwater marshes also being present. Saline wetlands consist of pickleweed, cord grass, glasswort, saltgrass, sea lavender, arrow grass, and shoregrass. These wetlands are very sensitive to fluctuations in water salinity, which are determined by water flows into the Delta (SFEP 1993).

There are pockets of water resulting from old channels that have been cut off from mainstem rivers entering the Delta as a result of channel meandering over time, or where dredge-mining activities have left deep depressions. These backwater areas typically contain large fringes of emergent and isolated vernal pools bordered by emergent marsh plants such as cattails and rushes. The calm waters provide excellent habitat for ducks such as cinnamon teal, American widgeon, and mallard.

The wetlands of the Delta represent habitat for a number of shorebirds and waterfowl species including killdeer, California black rail, western sandpiper, long-billed curlew, greater yellow-legs, American coot, American widgeon, gadwall, mallard, canvasback, and common moorhen. These areas also support a number of mammals such as coyote, gray fox, muskrat, river otter, and beaver. Several species of reptiles and amphibians also are present in this region.

A summary of special-status terrestrial species consulted on in the 2008 USFWS OCAP BO and their listing status is included in **Table 3-2**.

Table 3-2. Terrestrial Resources Special-Status Listing

Species	Scientific Name	Listing Status	
		Federal	State
Riparian brush rabbit	*Sylvilagus bachmani riparius*	Endangered	Endangered
Riparian woodrat	*Neotoma fuscipes riparia*	Endangered	--
Salt marsh harvest mouse	*Reithrodontomys raviventris*	Endangered	Endangered
California clapper rail	*Rallus longirostris obsoletus*	Endangered	Endangered
Giant garter snake	*Thamnophis gigas*	Threatened	Threatened
California red-legged frog	*Rana aurora draytonii*	Threatened	--
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened	--
Soft bird's beak	*Cordylanthus mollis ssp. Mollis*	Endangered	Endangered
Suisun thistle	*Cirsium hydrophilum var. hydrophilum*	Endangered	Endangered

Source: DFG 2008

The complex interface between land and water in the Delta has led to a rich and varied plant life that provides habitat for a diversity of wildlife species, especially birds. Wildlife habitats include agricultural land, riparian forest, riparian scrub-shrub, emergent freshwater marsh, heavily shaded riverine aquatic, and grassland/rangeland. Many species that either are listed or are candidates for listing as rare, threatened, and endangered inhabit the Delta.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Have a substantial adverse effect, either directly or through habitat modification, on any species identified as a sensitive, candidate, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?	☐	☐	☒	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands, as defined by §404 of the Clean Water Act (including, but not limited to, marsh,	☐	☐	☐	☒

vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☒	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

DISCUSSION

Fisheries Effects Assessment

Recent changes in operating criteria identified in the USFWS BO (2008) on the effects on delta smelt of the Coordinated Operation of the CVP and SWP, specifically the actions associated with RPA Components 1 and 2, improve habitat conditions and reduce losses to entrainment for delta smelt and other fishes in the Delta.

The BO identifies RPA components that address SWP related constraints to the recovery of delta smelt. These actions were developed based on the relationships between delta smelt entrainment and habitat conditions and various indicators of the influence of the projects on the hydrodynamics within the Bay-Delta. Because of the substantial overlap in timing and distribution of delta smelt and longfin in the Delta and the adaptive management process that provides for real time monitoring, triggers based on the data, and review by DFG and USFWS to determine appropriate actions, the actions and resulting SWP operations will cause no significant impact to longfin smelt. In fact, the actions will result in improved estuarine conditions resulting from a reduction in magnitude of negative OMR flows, increased delta outflow, reduced E/I ratio, QWEST (net flow of the San Joaquin River near the confluence with the Sacramento River) and more frequent seaward location of X2.

The actions (Actions 1 and 2) prescribed per RPA Component 1 are designed to reduce entrainment of pre-spawning adult and larval longfin smelt during December to March by controlling OMR flows during vulnerable periods. RPA Component 1 will also increase the spawning habitat for longfin smelt by decreasing the amount of Delta habitat affected by the projects prior to and during the critical spawning period. RPA Component 2 (Action 3 as well as Action 5) improves flow conditions in the Central and South Delta in the spring so that larval and juvenile longfin smelt can successfully rear and move downstream when appropriate.

A comparison is made between CalSim II model run 7.0, present, near-term and future Delta operations (Appendix 2). Given the actions are to be implemented in real time and therefore difficult to predict, the high and low possible operations were modeled. Appendix 2 describes the assumptions used for the model runs and provides results on the estuary conditions as well as the water supply impact of the proposed action (Figures A2-1 - A2-24). Implementation of the project would result in modest to substantial reductions in export rates, which in turn result in more positive OMR flows and potentially commensurate decrease in E/I ratio and increased Delta outflow. These substantial changes would not only protect longfin smelt, but it could improve overall habitat conditions during the winter-spring period for resident delta fish populations. In addition to improved habitat conditions, the reduction in entrainment conditions could increase survival of estuarine fish.

The combination of continued long-term operation of the SWP in the manner consistent with the protection and conservation of the longfin smelt, the implementation of the actions identified in the Project Description and subsequent take authorization would not result in impacts to longfin smelt or any other resident delta fish species.

For an analysis of the effects of the SWP on longfin smelt, past and future, see Appendix 3 (Draft Longfin Smelt Effects Analysis). This analysis will be a component of the CESA Incidental Take Permit application to DFG.

Terrestrial Resources Effects Assessment

The 2008 OCAP BA requested consultation on the effects of the continued operation of the SWP and CVP on the endangered riparian brush rabbit, endangered riparian woodrat, endangered salt marsh harvest mouse, endangered California clapper rail, threatened giant garter snake, threatened California red-legged frog, threatened valley elderberry longhorn beetle, endangered soft bird's beak, and the endangered Suisun thistle. The USFWS has concluded that the coordinated operations of the CVP and SWP are not likely to adversely affect these species (USFWS 2008). Thus, with the issuance of the take authorization and continued long-term operation of the SWP, no new impacts to terrestrial resources would occur.

a and d) The proposed project, issuance of a take authorization which will include the continued long-term operations of the SWP in addition to the implementation of certain elements of the RPA, would result in improvements to overall aquatic habitat conditions during the winter-spring period (e.g., controlling OMR flows during vulnerable periods to protect up migrating longfin smelt). Specifically, moderate to substantial changes in export rates would occur, which in turn would result in more positive OMR flows and potentially commensurate decreases in the E/I ratio, Delta outflow, and a more westward location of X2. These habitat improvements would benefit native resident or migratory Delta fish species, including improving migratory wildlife corridors and nursery sites.

The project area is known to have provided habitat for sensitive wildlife species, including the giant garter snake, California red-legged frog, and valley elderberry longhorn beetle. In the 2008 OCAP BO, USFWS determined that the coordinated operations of the CVP and SWP are not likely to adversely affect these sensitive wildlife species. Therefore, there would be no new impacts to terrestrial resources due to the project.

b) The proposed project does not include any construction, modification of landforms, or changes in water operations or facilities. Therefore, the proposed project would not result in any new adverse impacts upon any riparian habitat or other sensitive natural communities identified in local or regional plans, policies, or regulations, or by the DFG or USFWS, within the project area.

c) The proposed project does not include any construction, modification of landforms, or changes in water operations or facilities. Therefore, the proposed project would not result in any new adverse impacts upon any federally protected wetlands as defined by

Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.).

e and f) The proposed project does not include any construction, modification of landforms, or changes in water operations or facilities. No trees would be removed for the project, and no conflicts with policies protecting biological resources would result. The proposed project would not be in conflict with the provisions of any adopted Habitat Conservation Plan, Natural Community Conservation Plan or other approved local, regional, or state habitat conservation plan. Therefore, the project would not result in any impacts to biological plans, polices or conservation plans.

V. CULTURAL RESOURCES

ENVIRONMENTAL SETTING

The Delta Region is one of the most intensely investigated areas of California because of its high prehistoric population density and proximity to population centers. Although the bulk of the cultural resources sites were recorded prior to 1960, there has been little systematic inventory for cultural resources. Most of the early archeological work in the region focused on prominent prehistoric mounds. Later work has recorded a more diverse, but less impressive range of sites. Documentation of historic sites has largely occurred only in the last 20 to 30 years.

Types of prehistoric sites that have been recorded in the Delta Region include village sites, temporary camp sites, milling-related activity sites, and lithic scatters. Several Native American groups occupied portions of the Delta Region. The Valley Nisenan occupied the far northeastern portion. The Plains and Bay Miwok originally were found in the eastern and far western portions of the area. The south Delta was occupied by the Northern Valley Yokuts. The north shore of Suisun Bay was settled by the Patwin. These cultures were rapidly reduced by missionization, epidemics, and European contact resulting from in-migration during the Gold Rush.

Potential historic resources in the Delta Region are largely related to agriculture; however, other types of resources also are present, including farmsteads, labor camps, landings for the shipment of agricultural produce, canneries, pumping stations, siphons, canals, drains, unpaved roads, bridges, and ferry crossings. Due to the extensive use of the land in historic times, architectural resources are likely to occur throughout the region. However, much of the region is still used for agricultural purposes, where the ground surface is regularly plowed, raked, or tilled (CALFED 2000).

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Cause a substantial adverse change in the significance of a historical resource, as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource, pursuant to §15064.5?	☐	☐	☐	☒
c) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒

DISCUSSION

a - c) The proposed project would not involve any construction or other land-disturbing activities and therefore would not result in a substantial adverse change to historical, archaeological, or paleontological resources or sites, including any unique geologic features. Additionally, it would not be expected that the proposed project would result in the disturbance of any human remains. Therefore, there are no impacts to cultural resources as a result of project implementation.

VI. GEOLOGY AND SOILS

ENVIRONMENTAL SETTING

The Delta is in the Great (Central) Valley Geomorphic Province, a valley trough that extends over 400 miles from north to south and consists of the Sacramento and the San Joaquin valleys. It is divided into two sub-basins, the Sacramento and the San Joaquin.

The present geomorphic state of the Delta is a function of the intensity of water management in each of the tributary rivers, local farming practices, intra- and inter-Delta water transfers and an extensive human-made levee system (Reclamation and DWR 2005). The soils of the Delta region vary primarily as a result of differences in geomorphologic processes, climate, parent material, biologic activity, topography, and time (CALFED 2000).

Subsidence of the Delta's organic soils and highly organic mineral soils continues to be a concern. Interior Delta island subsidence is attributable primarily to biochemical oxidation of organic soil material as a result of long-term drainage and flood protection. The highest rates of subsidence occur in the central Delta islands, where organic matter content in the soils is highest (CALFED 2000).

The primary seismic threat to the Delta is levee failure resulting from lateral displacement and deformation, with resultant breaching or mass settlement due to ground shaking and liquefaction of levee materials. Many levees include sandy sections with low relative density and high susceptibility to liquefaction. Therefore, the seismic risk to Delta levees varies significantly across the Delta, depending on the proximity to the source of the earthquake and the conditions of the levee and levee foundation. The State of California provides minimum standards for building design and construction through California Building Standards Code (California Code of Regulations, Title 24). Specific minimum seismic safety and structural design requirements are set forth in Chapter 16 of the California Building Standards Code. The State earthquake protection law (Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stress caused by wind and earthquakes.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map, issued by the State Geologist for the area, or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒

LESS THAN

		POTENTIALLY SIGNIFICANT IMPACT	SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
b)	Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c)	Be located on a geologic unit or soil that is unstable, or that would become unstable, as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☐	☒
d)	Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life or property?	☐	☐	☐	☒
e)	Have soils incapable of adequately supporting the use of septic tanks or alternative waste disposal systems, where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
f)	Directly or indirectly destroy a unique paleontological resource or site, or unique geologic feature?	☐	☐	☐	☒

DISCUSSION

a - f) The proposed project would not involve the construction or modification of structures that could be adversely affected by seismic events. Additionally, because implementation of the proposed project does not involve construction activities nor provide indirectly or directly for new populations, the proposed project would not expose people or structures to geologic hazards such as ground failure or liquefaction, would not result in increased potential for substantial soil erosion or loss of topsoil, and would not increase the potential for landslides. Therefore, there is no impact to geology or soils as a result of the project.

VII. HAZARDS AND HAZARDOUS MATERIALS

ENVIRONMENTAL SETTING

Hazardous materials and wastes are those materials that, because of their physical, chemical, or other characteristics, may pose a risk of endangering human health or safety or of endangering the environment (California Health and Safety Code Section 25260). In the Delta, most hazardous waste sites are associated with agricultural production activities and may include storage facilities and agricultural pits or ponds contaminated with fertilizers, pesticides, or herbicides (Reclamation and DWR 2005). Other potential human health hazards in the Delta include drinking water contamination, mosquito and other disease transmission vectors, and wildfires.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials, substances, or waste into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites, compiled pursuant to Government Code §65962.5, and, as a result, create a significant hazard to the public or environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f) For a project located in the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury, or death from wildland fires, including areas where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒

DISCUSSION

a-h) The proposed project does not include any new construction or use of hazardous materials and there would be no transport, use, or disposal of hazardous materials. Therefore, there would be no adverse effects on an airport land use plan or a private air strip. The proposed project would not conflict with any state or federal laws related to hazardous material management including regulations for hazardous material cleanup, storage, testing procedures, and quantity reduction. In addition, the project will not interfere with adopted emergency response or evacuation plans, nor will it affect exposure of people or structures to wildfires. Therefore, no impact to hazards or hazardous materials will result with implementation of the proposed project.

VIII. HYDROLOGY AND WATER QUALITY

ENVIRONMENTAL SETTING

The Delta is part of California's largest estuary, a major source of water for municipal, agricultural, recreational, and industrial uses. The sloughs and channels of the Delta form more than 60 islands and tracts, which contain about 520,000 acres devoted to farming. An approximate 1,110-mile network of levees protects the islands and tracts, almost all of which lie below sea level, from flooding. Prior to development, which began in the mid-19th century, the Delta was mainly tule marsh and grassland, with some high spots rising to a maximum of 10 to 15 feet msl.

Water resources in the Delta consist of surface water and groundwater. The source of the majority of this water is freshwater drainage inflow, with the remainder being rainfall and recycled water from wastewater treatment plants.

The Delta is the primary source of the State’s freshwater, providing drinking water for two-thirds of the State, but most of the population of the State resides elsewhere. Approximately 75 percent of the State’s freshwater originates north of the City of Sacramento, while 75 percent of the water needs occur south of Sacramento. The Delta is the southernmost point from which substantial amounts of freshwater of sufficient quality can be extracted from the Sacramento River before draining into the San Francisco Bay. For this reason, the Delta has been developed into the hub of the State’s water redistribution system.

The two main water diversion programs are the SWP and CVP. Local agencies, such as the City of Vallejo, also operate their own diversion programs, using Contra Costa Canal, North Bay Aqueduct, and other local diversion infrastructure. Direct diversion by private entities, such as Western Delta Industry and 1,800-plus agricultural users, also occur in the Delta. Because both the SWP and CVP convey water in the Sacramento River and the Delta, facility operations are coordinated based on the Coordinated Operating Agreement, the Bay-Delta Plan Accord, and many other agreements.

Various water quality and flow objectives have been established to ensure that the quality of Delta water is sufficient to satisfy all designated uses; implementation of these objectives requires that limitations be placed on Delta water supply operations, particularly operations of the SWP and CVP affecting amounts of fresh water and salinity levels in the Delta (Reclamation and DWR 2005). Protective actions are being implemented by DWR to not only protect longfin smelt but also protect delta smelt and other fisheries and aquatic life. One protective measure is to maintain and improve dominant water quality variables that influence habitat and food-web relationships in the Delta (e.g. temperature, salinity, and suspended sediments, etc) (Reclamation and DWR 2005).

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge, such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through alteration of the course of a stream or river, in a manner which would result in substantial on- or off-site erosion or siltation?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in on- or off-site flooding?	☐	☐	☐	☒
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Substantially degrade water quality?	☐	☐	☐	☒
g) Place housing within a 100-year flood hazard area, as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map, or other flood hazard delineation map?	☐	☐	☐	☒
h) Place structures that would impede or redirect flood flows within a 100-year flood hazard area?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury, or death from flooding, including flooding resulting from the failure of a levee or dam?	☐	☐	☐	☒
j) Result in inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒

DISCUSSION

a - j) The proposed project does not include any construction or re-operation of water quality facilities. The project would not result in discharges to Delta waters, affect groundwater supplies, impact runoff patterns or water quality, influence flooding patterns, expose structures or people to flooding, or cause inundation by seiche, tsunami, or mudflow. Therefore, the proposed project will not impact hydrology or water quality. The changes in operations of the SWP export facilities are described in Section IV and illustrated in Appendix 2 (Figures A2-1 - A2-24).

IX. LAND USE AND PLANNING

ENVIRONMENTAL SETTING

The Legal Delta, as defined in Section 12220 of the California Water Code, is subject to land use planning and regulation by various cities and counties. Additionally, other State and local agencies are responsible for land use planning in the Delta. The State Lands Commission has jurisdiction over submerged lands of the state and protects the public trust values, including easements for water-borne commerce, navigation, fisheries, recreation, and open space. A variety of land use planning documents have been developed for the Delta region, including regional plans, strategic plans, general plans, city plans, and community and specific plans. The passage of the Delta Protection Act of 1992 (California Water Code Section 12220) established the Delta Protection Commission. The Delta Protection Commission has land use planning jurisdiction over the Primary Zone, which generally consists of the central portion of the Delta. The Delta Protection Commission is charged with preparation of a regional plan for the Primary Zone. The purpose of this regional plan is to address land uses and resource management for the Legal Delta, with particular emphasis on agriculture, wildlife habitat, and recreation.

Approximately 71,000 acres (about 8%) in the Delta Region are urbanized, with most of the development on the periphery of the region in Sacramento, San Joaquin, and Contra Costa counties. Much of the urbanization in the region is centered in incorporated cities, such as Antioch, Brentwood, Isleton, Pittsburg, Rio Vista, Sacramento, and West Sacramento. Fourteen unincorporated communities also are in the Delta Region: Discovery Bay, Oakley, Bethel, Courtland, Freeport, Hood, Ryde, Walnut Grove, Byron, Terminous, Thornton, Hastings Tract, and Clarksburg (CALFED 2000).

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with the applicable land use plan, policy, or regulation of any agency with jurisdiction over the project (including, but not limited to, a general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

DISCUSSION

a - c) The proposed project does not involve any construction of facilities or changes in operations, and therefore would not result in division of an established community and would not conflict with applicable land use plans, policies or regulations, including the general plan and zoning ordinances. Additionally, the proposed project would be implemented in accordance with any applicable habitat conservation or natural community conservation plans. Thus, there is no impact to land use and planning as a result of implementing the project.

X. MINERAL RESOURCES

ENVIRONMENTAL SETTING

The Delta is an area with considerable natural gas resources, and is a significant source of natural gas production. The Delta contains natural gas drilling sites, gas fields, wells, storage fields, and distribution pipelines.

To protect valuable mineral resources, the California Surface Mining and Reclamation Act was enacted in 1975 by the State Legislature to regulate activities related to mineral resource extraction. This act encourages both the conservation and production of extractive mineral resources, requiring the State Geologist to identify the state's varied extractive resource deposits. The California Department of Conservation has identified significant mineral deposits, such as aggregates, in the Delta.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Result in the loss of availability of a known mineral resource that is or would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

DISCUSSION

a - b) The proposed project would not result in the loss of availability of a known mineral resource that is valued by the region or residents because the project does not involve construction or land disturbance activities. The proposed project also would not result in the loss of availability of any locally important mineral recovery site that has been delineated on a local plan. Therefore, no loss of mineral resources would occur as a result of the proposed project and there would be no impact on mineral resources.

XI. NOISE

ENVIRONMENTAL SETTING

The Delta contains a broad range of settings, from developed urban areas and serene wilderness refuge for wildlife. Noise-sensitive land uses are generally defined as any type of location or land use where people reside or where the presence of unwanted sound could adversely affect the use of the land. Noise-sensitive land uses typically include residences, hospitals, schools, libraries, and certain types of recreational uses.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Generate or expose people to noise levels in excess of standards established in a local general plan or noise ordinance, or in other applicable local, state, or federal standards?	☐	☐	☐	☒
b) Generate or expose people to excessive groundborne vibrations or groundborne noise levels?	☐	☐	☐	☒
c) Create a substantial permanent increase in ambient noise levels in the vicinity of the project (above levels without the project)?	☐	☐	☐	☒
d) Create a substantial temporary or periodic increase in ambient noise levels in the vicinity of the project, in excess of noise levels existing without the project?	☐	☐	☐	☒
e) Be located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport? If so, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) Be in the vicinity of a private airstrip? If so, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

DISCUSSION

a - f) The proposed project does not include any type of construction, land disturbance or noise-generating activities and, therefore, would not increase the ambient noise levels or result in degradation of the existing ambient noise environment. The proposed project would not generate any new or increased noise levels and also would not conflict with general plan or specific plan noise elements or noise ordinances for other counties or cities within the project area. Therefore, the proposed project would have no impact on noise.

XII. POPULATION AND HOUSING

ENVIRONMENTAL SETTING

Population and housing data is available on the Census Bureau website. **Table 3-3** provides a summary of the 2006 population estimate, 2000 census data for households, and 2006 housing unit estimate for the five counties located in the Delta, although it is recognized that portions of these counties lie outside of the Legal Delta.

Table 3-3. Summary and Housing Data

County	Population Estimate (2006)[1]	Households (2000)[2]	Housing Units (2006)
Contra Costa	1,024,319	344,129	389,100
Sacramento	1,374,724	453,602	542,499
San Joaquin	673,170	181,629	223,441
Solano	411,680	130,403	148,851
Yolo	188,085	59,375	70,679

1 - The Census Bureau's Population Estimates Program (PEP) produces July 1 estimates for years after the last published decennial census (2000).
2 - A household includes all the persons who occupy a housing unit.
Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, Census of Population and Housing, Small Area Income and Poverty Estimates, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits, Consolidated Federal Funds Report

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

DISCUSSION

a - c) The proposed project does not involve any construction of facilities or changes in operations, and does not involve a proposal for residences or businesses or the extension of access to any area. The proposed project also would not displace existing housing or people, nor would it create an indirect need for housing. Therefore, the project would have no impact on population growth or housing requirements in the area and would have no impact on population and housing.

XIII. PUBLIC SERVICES

ENVIRONMENTAL SETTING

Public services, including police, fire, and ambulance services in the Delta area are provided in part by each of the five counties (Contra Costa, Sacramento, San Joaquin, Solano and Yolo) and three major cities (Sacramento, Stockton and West Sacramento) in the area. Additionally, numerous private and public schools and public parks exist throughout the Delta region.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Result in significant environmental impacts from construction associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:	☐	☐	☐	☒
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

DISCUSSION

a) The proposed project does not include any type of construction, and therefore would not result in the provision of new or physically altered government facilities and therefore, would not impact the service ratios, response times, or other performance objectives for public services. The proposed project also would not result in the need for any additional fire protection, police protection, schools, parks, or other public facilities. Therefore, the proposed project would have no impact on public services.

XIV. RECREATION

As a complex of waterways affected by both freshwater inflows and tidal action, the Delta is a very important recreation resource that provides a variety of water-dependent and water-enhanced recreation opportunities. Boating is the most popular activity in the Delta region, accounting for approximately 17 percent of visitation, with other popular uses including fishing, relaxing, sightseeing, and camping (DWR and Reclamation 1996). Boating and related facilities are located throughout the Delta and include launch ramps, marinas, boat rentals, swimming areas, camping sites, dining and lodging facilities, and marine supply stores. Most recreation facilities are privately owned and operated commercially.

Located near several metropolitan areas, the Delta supports about 12 million user days of recreation a year (DWR 1993). Parks along the mainstem of the Sacramento River and Delta sloughs provide access for water-oriented recreation as well as picnic sites and camping areas. Brannan Island State Park and Delta Meadows River Park are major water-oriented recreational areas. Use of these parks typically peaks in July.

Current recreation in the Delta is primarily water-oriented, although not all recreation activities are associated with water. The more popular land-based recreation activities include hunting, camping, picnicking, walking for pleasure, bicycling, wildlife viewing, photographing wildlife, sightseeing (driving for pleasure), and attending special events.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Increase the use of existing neighborhood and regional parks or other recreational facilities, such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☐	☒

DISCUSSION

a - b) The proposed project would not result in increased use of existing neighborhood or regional parks or other recreational facilities resulting in physical deterioration of such facilities. The proposed project also would not construct or expand recreational facilities causing adverse physical effects on the environment. Therefore, there would be no impact to recreation or recreational facilities with implementation of the proposed project.

XV. TRANSPORTATION/TRAFFIC

ENVIRONMENTAL SETTING

Circulation patterns have been established throughout the Delta, including a network of federal, state, local and private roads, airways, and rail systems. The various jurisdictions establish parking standards, emergency access routes and other transportation criteria, including construction and design standards. The transportation network in the Delta is comprised of a series of highways, roads, railroads and waterways. The Delta is crossed by Interstate Highways 5, 80 and 205, and State Highways 4, 12 and 160. The Southern Pacific/Union Pacific, Atchison, Topeka and Santa Fe, and Sacramento Northern railroads transport goods across and throughout the Delta. Additionally, the Deepwater Ship Channel services the ports of Sacramento and Stockton (DWR Website 2009).

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Cause a substantial increase in traffic, in relation to existing traffic and the capacity of the street system (i.e., a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?	☐	☐	☐	☒
b) Exceed, individually or cumulatively, the level of service standards established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to design feature (e.g., sharp curves or a dangerous intersection) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒

DISCUSSION

a - g) The proposed project would not directly increase the travel demand on any existing roadways or create the need for new roadways, or exceed the level of established roadway service standards. The proposed project also would not affect air traffic. The proposed project does not include any type of construction, and therefore would not contain any design features or uses that would affect traffic hazards, parking capacity, or adopted policies, plans, or programs supporting alternative transportation. Accordingly, the proposed project would have no impact on transportation or traffic.

XVI. UTILITIES AND SERVICE SYSTEMS

ENVIRONMENTAL SETTING

The Delta is serviced by multiple utilities and public services, which include several types of distribution systems for electricity, petroleum and gas, telecommunications, and water.

Most water conveyance facilities in the Delta have been developed under the authority of the federal government's CVP and California's SWP. As part of CVP development, exportation of water from the Delta began in 1940 with the completion of the Contra Costa Canal. Other major federal units were completed during the early 1950s, including the Delta-Mendota Canal and the Delta Cross Channel (DCC). The DCC transfers water across the Delta from the Sacramento River to the Jones Pumping Plant, which serves the Delta-Mendota Canal. Numerous SWP facilities have been developed in the Delta, including the Banks Pumping Plant, the California Aqueduct, and the North Bay Aqueduct.

Water conveyance infrastructure consists of a multitude of agricultural, industrial, and municipal diversions for supplying water to the Delta itself and for export by the SWP and CVP. Diversions and conveyance require canals, waterways, levees, siphons, pumps, radial gates, and other miscellaneous infrastructure.

Power transmission facilities have developed parallel to the population growth of various communities surrounding the Delta. Pacific Gas and Electric Company and the Western Area Power Administration have developed power transmission lines across the Delta islands and waterways. Many of the corridors are within the periphery of the Delta upland areas, including several natural gas-fired plants. Power-generating facilities are absent from the Central Delta. Communication infrastructure in the region includes underground cable and fiber optic lines, and communication/transmission towers.

Natural gas was discovered in the Delta Region in 1935 and has since been developed into a significant source supply and depot for underground storage. Gas fields, pipelines, underground storage areas, and related infrastructure are located in the Delta. Infrastructure consists mainly of pipelines and storage facilities owned by oil and gas companies, public utilities, and various independent leaseholders.

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Exceed wastewater treatment restrictions or standards of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities?	☐	☐	☐	☒
Would the construction of these facilities cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities?	☐	☐	☐	☒

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
Would the construction of these facilities cause significant environmental effects?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the project from existing entitlements and resources or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination, by the wastewater treatment provider that serves or may serve the project, that it has adequate capacity to service the project's anticipated demand, in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations as they relate to solid waste?	☐	☐	☐	☒

DISCUSSION

a - g) The proposed project does not involve any construction, and would not result in any additional discharges of wastewater, stormwater, drainage, or solid wastes. Therefore, no wastewater treatment standards would be violated, no additional water treatment or stormwater drainage facilities would need to be constructed, and no solid waste regulations or standards would be violated. Under the proposed project, current water supplies would continue to be delivered to project water users under existing entitlements. Therefore, the proposed project would not result in impacts to utilities and service systems.

CHAPTER 4
MANDATORY FINDINGS OF SIGNIFICANCE

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal?	☐	☐	☒	☐
b) Have the potential to eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
c) Have impacts that are individually limited, but cumulatively considerable? (“Cumulatively considerable” means the incremental effects of a project are considerable when viewed in connection with the effects of past projects, other current projects, and probably future projects?)	☐	☐	☐	☒
d) Have environmental effects that will cause substantial adverse effects on humans, either directly or indirectly?	☐	☐	☐	☒

DISCUSSION

a) The proposed project does not include any construction, modification of landforms, or changes in water operations or facilities. Compliance with the measures in the take authorization will, in fact, give additional protective measures to endangered and threatened species. Therefore, the proposed project would not result in any degradation to the environment, reduce habitat, or cause a fish or wildlife population to drop below or be threatened with elimination. The overall impact is beneficial.

b) The proposed project does not include any construction or changes in water operations or facilities. The proposed project will not create any new impacts to California history or prehistory (see Section V, Cultural Resources above).

c) In consideration of relevant past current and probable future projects, and the beneficial nature of the proposed project, the proposed project is not anticipated to result in any cumulative impacts.

d) The proposed project will not result in any new adverse direct or indirect effects to humans (see Chapter 3 above).

CHAPTER 5
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Chapter 6
REPORT PREPARATION

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APPENDIX 1
PROJECT AREA MAP

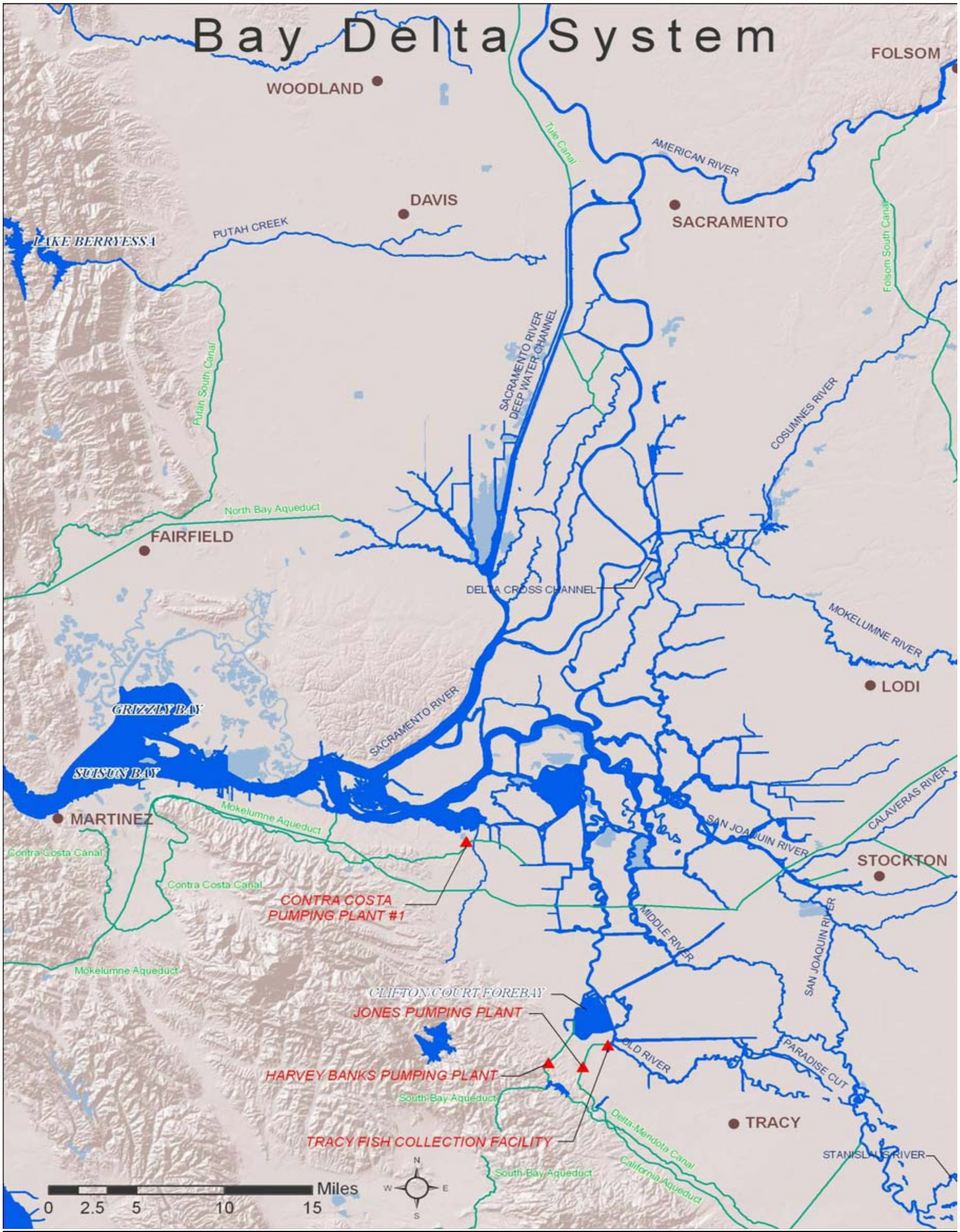

Figure A-1. Bay Delta System (Source: USFWS 2008)

Appendix 2

CalSim II Modeling Assumptions and Results

CalSim II Modeling Assumptions and Results

Appendix 2 describes the assumptions used for the CalSim II model runs and shows changes in the estuary conditions as well as the water supply impact of the actions (Figures A2-1 - A2-24). Implementation of the project would result in modest to substantial reductions in export rates, which in turn result in more positive OMR flows and potentially commensurate decrease in E/I ratio and outflow.

The SWC Delta operations assessment for this Initial Study was conducted using the CalSim II simulation model. The base models originated from the modeling conducted for the 2008 OCAP Biological Assessment (BA) (Reclamation 2008). The BA includes the details on the CalSim assumptions and modeling in Chapter 9 and Appendix D.

A total of six studies were conducted for this analysis. The three base studies (present, near- term and future) were from the OCAP BA but were modified to incorporate the logic needed to model portion of the reasonable and prudent alternative (RPA) in the Fish and Wildlife Service Biological Opinion (USFWS 2008) that was accepted by the Bureau of Reclamation. The three OCAP BA base models used for this analysis were the OCAP Study 7.0, Study 7.1, and Study 8.0. Study 7.0 is the existing condition and represents the existing infrastructure and demands. Study 7.1 is the near-future condition and represents near-term future infrastructure improvements and existing demands. Study 8.0 is the future condition and represents future infrastructure improvements and future demands.

The modeling completed for this analysis used only a D-1641 step. This is different from the modeling that was completed for the OCAP BA. The OCAP BA modeling included a Central Valley Project Improvement Act (CVPIA) 3406(b)(2) step, which estimated use of (b)(2) water, as well as an Environmental Water Account (EWA) step that modeled the current EWA and limited version of EWA. These steps were not modeled due to complexities of modeling the new USFWS RPA and the uncertainty of how (b)(2) and EWA would be implemented.

The six studies were conducted to include three studies presented in the 2008 OCAP BA as well as to provide boundaries on the Old and Middle River (OMR) restriction. These high and low characterizations of the SWP operations were based on possible operations under the OCAP BO. The high and low bounds do not include the possible extremes that the DWR may need to operate to; however, based on past implementation of similar actions, the boundaries should give a reasonable representation of the year-to-year variability of these actions.

The D1641 step from each model was modified to operate to the USFWS RPA. Additional code was included in the model to restrict Banks and Jones pumping plants in order to meet the specified OMR target. The following is a summary of the ranges assumed in the modeling, and Table 1 summarizes the assumptions for each study.

- Action 1: To protect upmigrating delta smelt. This action can start as early as December 1, based on the judgment of the USFWS, but after December 20 this action is based on turbidity and delta smelt salvage at the exports. To model this action, the high and low bound OMR restriction was assumed to be -2000 cfs and -2400 cfs starting December 18 and ending December 31.

- Action 2 – To protect adult delta smelt that have migrated upstream and are residing in the Delta prior to spawning. This action would commence immediately after Action 1. To model this action, a high and low bound OMR restriction was assumed to be -3500 cfs and -5000 cfs starting January 1 and ending the last day in February.

- Action 3 – To improve flow conditions in the Central and South Delta so that larval and juvenile delta smelt can successfully rear in the Central Delta and move downstream when appropriate. The initiation of this action is based on temperature and evidence of spawning. To model this action, an OMR restriction was assumed to have a pre-VAMP target starting March 1 and ending May 15 and a post-VAMP target starting May 16 and ending June 15 for the lower bound and June 30 for the higher bound. The pre-VAMP OMR restriction was -2000 cfs and -3000 cfs and the post-VAMP OMR restriction was -2500 cfs and -3500 cfs.

Table 1 Applied Actions for each FWS BO RPA.

Study Name	OCAP Base Study	Action 1	Action 2	Action 3 (Pre-VAMP)	Action 3 (Post-VAMP)
Existing High	Study 7.0	Dec 18 to Dec 31 OMR>-2000 cfs	Jan 1 to Feb 28 OMR>-3500 cfs	Mar 1 to May 15 OMR>-2000 cfs	May 16 to Jun 30 OMR>-2500 cfs
Existing Low	Study 7.0	Dec 18 to Dec 31 OMR>-2400 cfs	Jan 1 to Feb 28 OMR>-5000 cfs	Mar 1 to May 15 OMR>-3000 cfs	May 16 to Jun 15 OMR>-3500 cfs
Near Future High	Study 7.1	Dec 18 to Dec 31 OMR>-2000 cfs	Jan 1 to Feb 28 OMR>-3500 cfs	Mar 1 to May 15 OMR>-2000 cfs	May 16 to Jun 30 OMR>-2500 cfs
Near Future Low	Study 7.1	Dec 18 to Dec 31 OMR>-2400 cfs	Jan 1 to Feb 28 OMR>-5000 cfs	Mar 1 to May 15 OMR>-3000 cfs	May 16 to Jun 15 OMR>-3500 cfs
Future High	Study 8.0	Dec 18 to Dec 31 OMR>-2000 cfs	Jan 1 to Feb 28 OMR>-3500 cfs	Mar 1 to May 15 OMR>-2000 cfs	May 16 to Jun 30 OMR>-2500 cfs
Future Low	Study 8.0	Dec 18 to Dec 31 OMR>-2400 cfs	Jan 1 to Feb 28 OMR>-5000 cfs	Mar 1 to May 15 OMR>-3000 cfs	May 16 to Jun 15 OMR>-3500 cfs

The CalSim II logic for operating to the USFWS BO RPA is new and refinements are ongoing. Future enhancements will also include more sophisticated triggering of actions and the addition of (b)(2) and EWA. In addition, the assumption that available export under OMR restrictions will be split equally between the SWP and CVP is not currently covered by formal agreement. However, this modeling effort does represent the best available at this time.

Figures of the CalSim II results of the average monthly, wet, above normal, below normal, dry and critical monthly flows for SWP export pumping at Banks, the North Bay Aqueduct, Outflow and Export/Inflow ratio are provided below.

SWP Banks Pumping

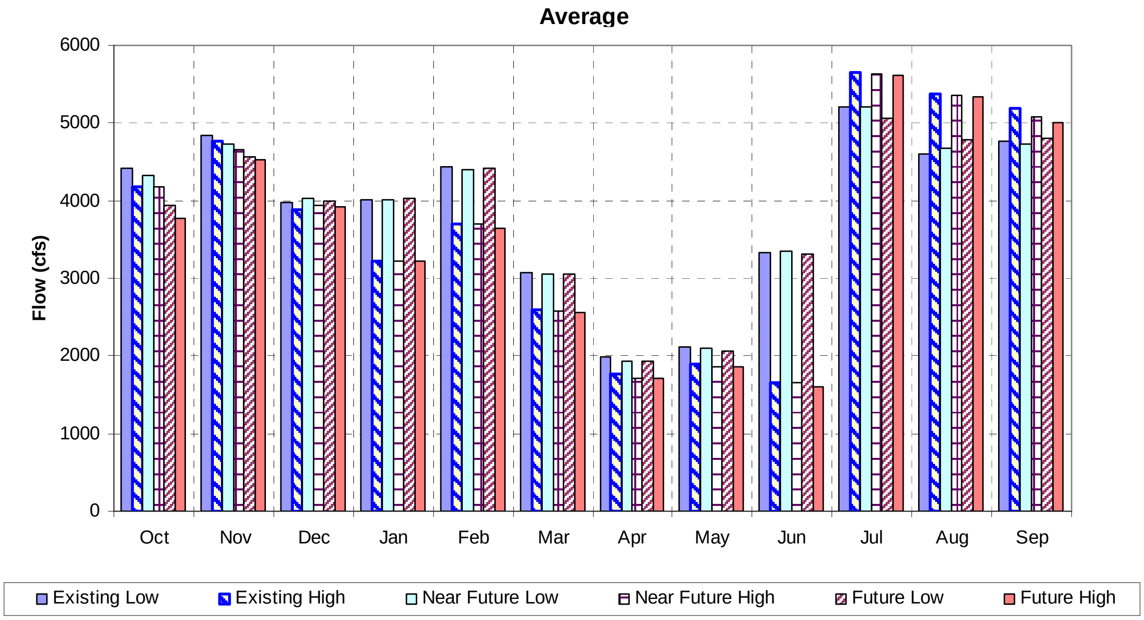

Figure A2-1. Average monthly Banks pumping.

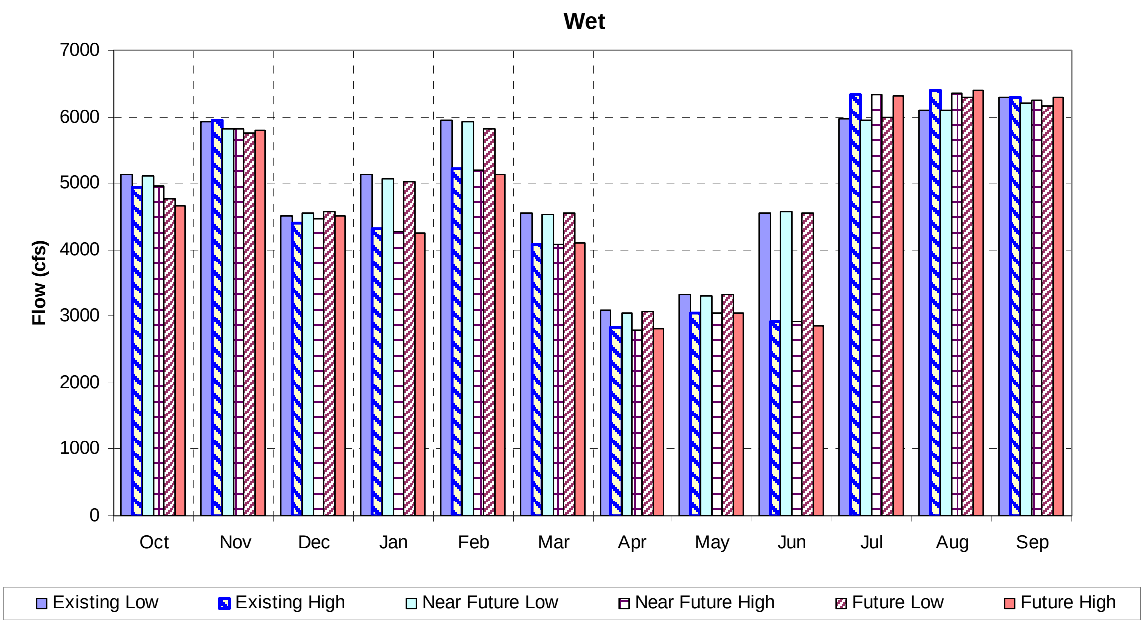

Figure A2-2. Average wet year (40-30-30 Classification) monthly Banks pumping.

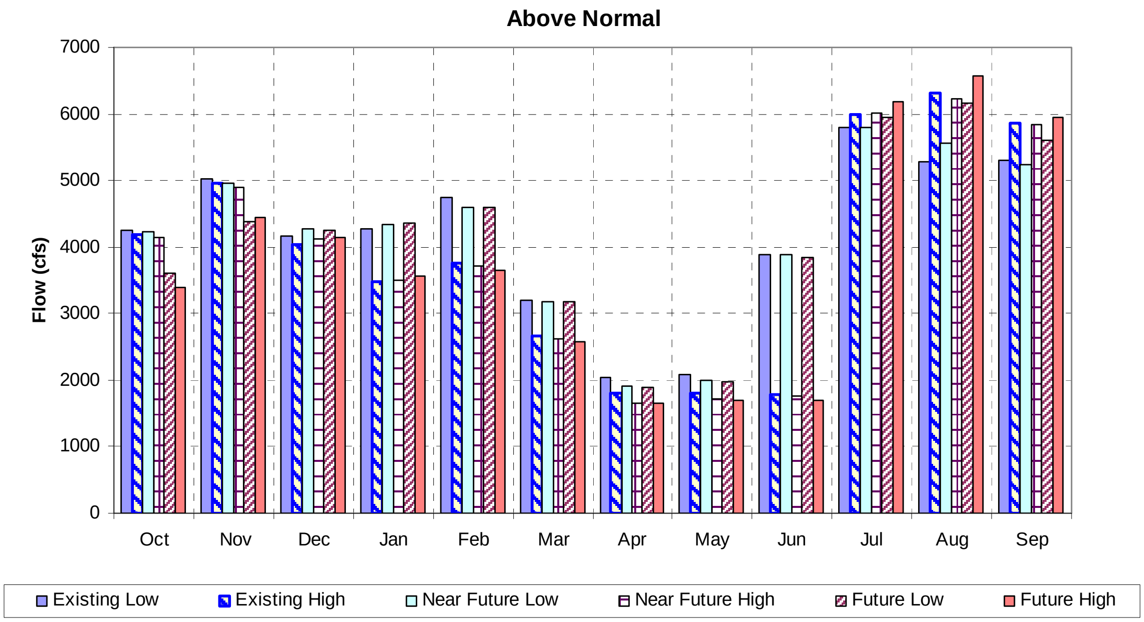

Figure A2-3. Average above normal year (40-30-30 Classification) monthly Banks pumping.

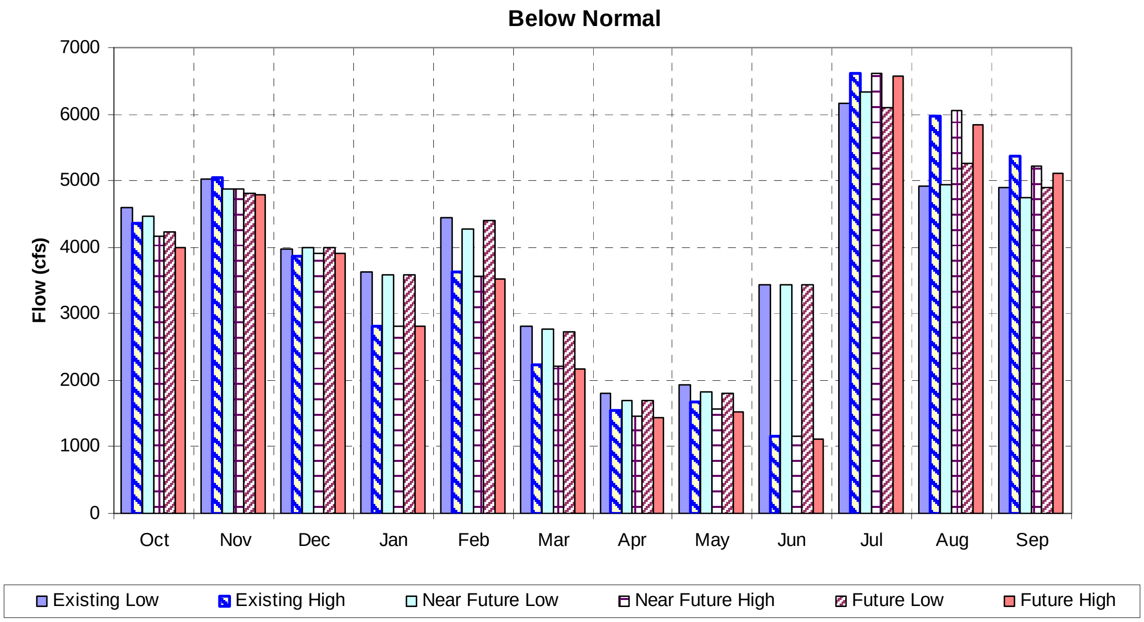

Figure A2-4. Average below normal year (40-30-30 Classification) monthly Banks pumping.

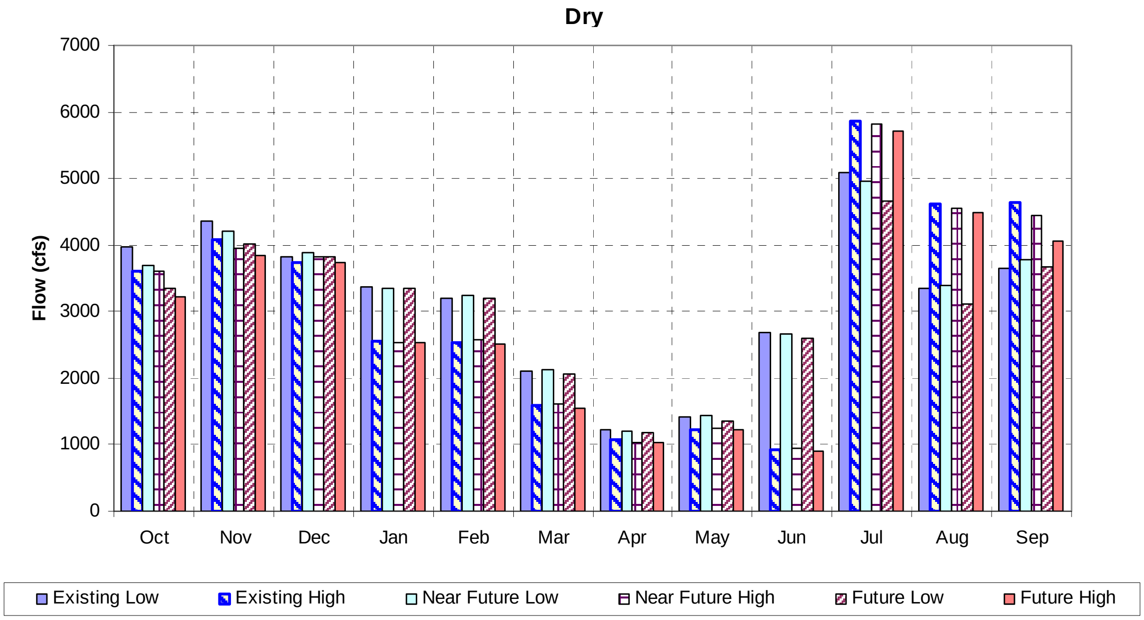

Figure A2-5. Average dry year (40-30-30 Classification) monthly Banks pumping.

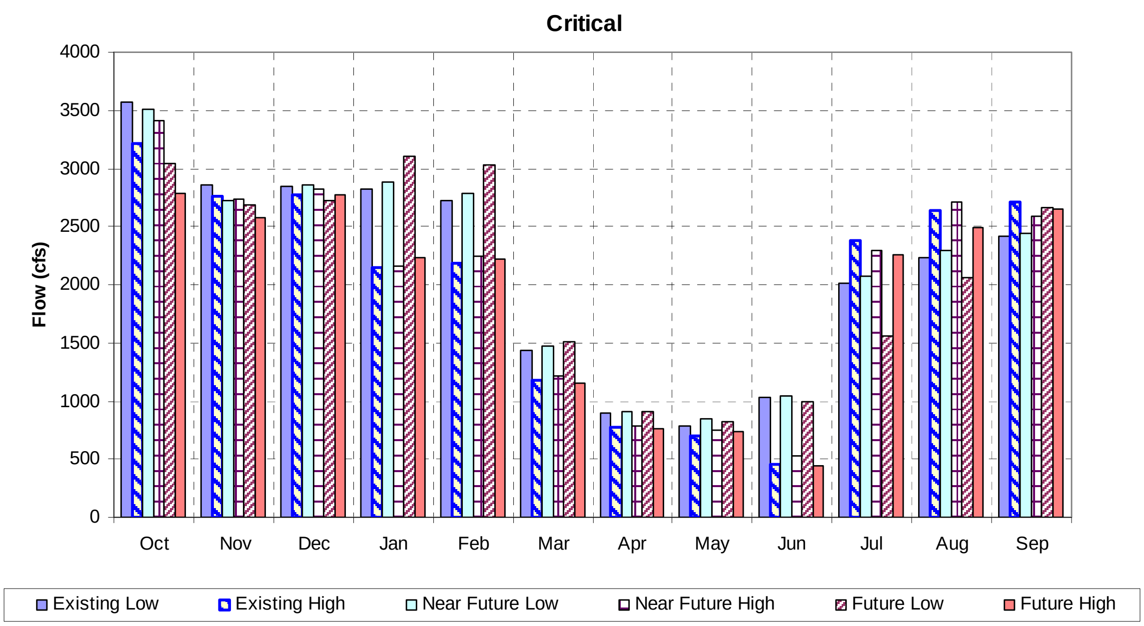

Figure A2-6. Average critical year (40-30-30 Classification) monthly Banks pumping.

North Bay Aqueduct Pumping

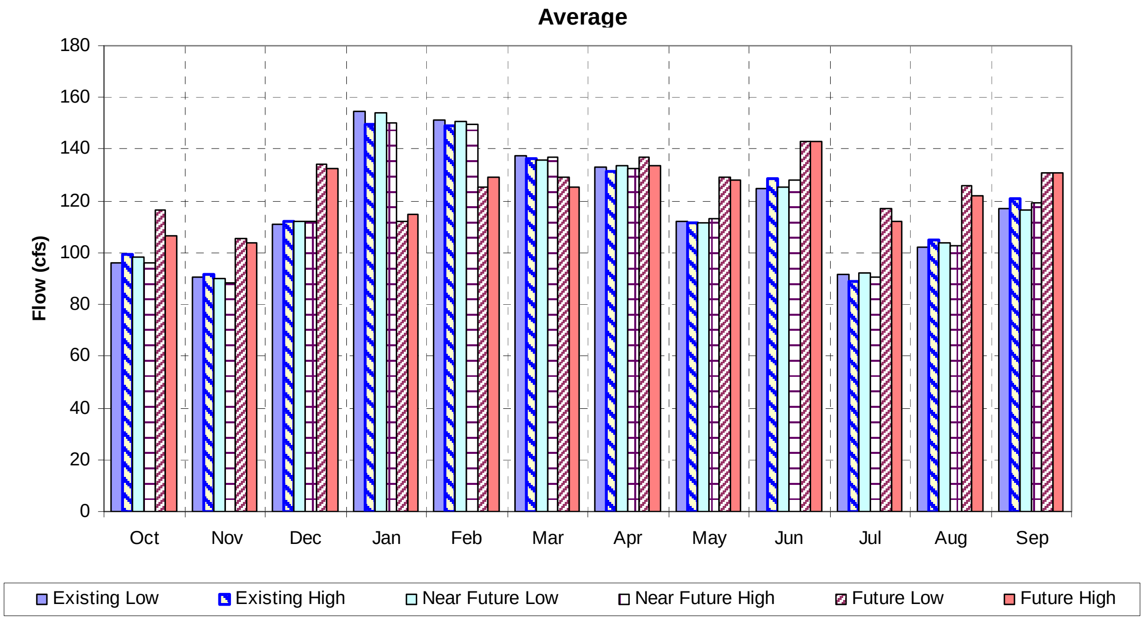

Figure A2-7. Average monthly North Bay Aqueduct diversions from the Delta.

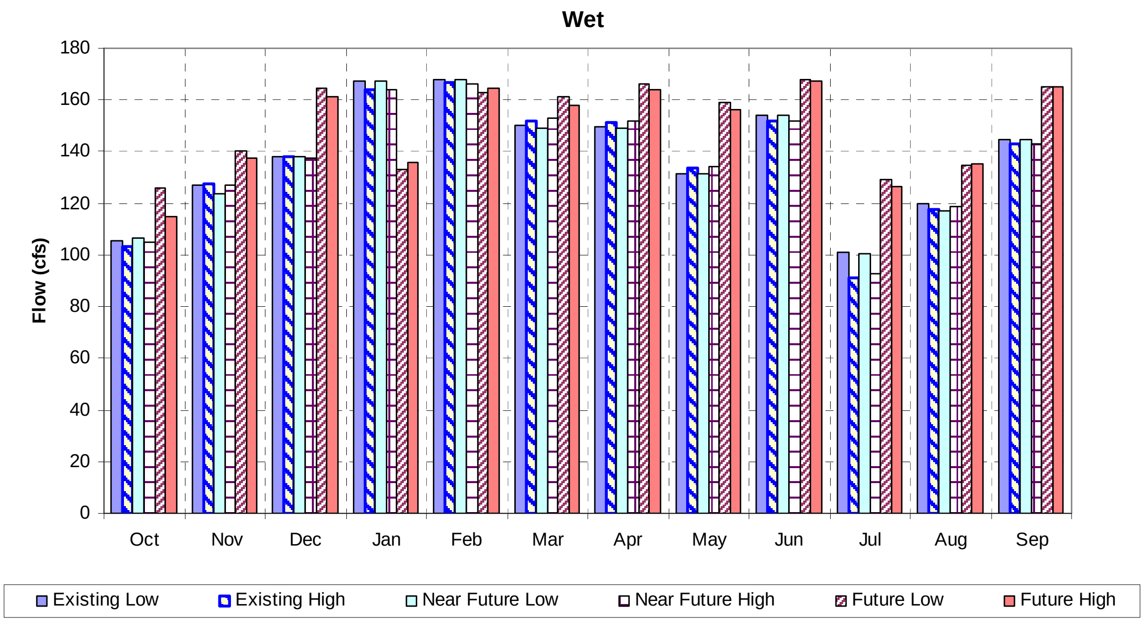

Figure A2-8 . Average wet year (40-30-30 Classification) monthly North Bay Aqueduct diversions from the Delta.

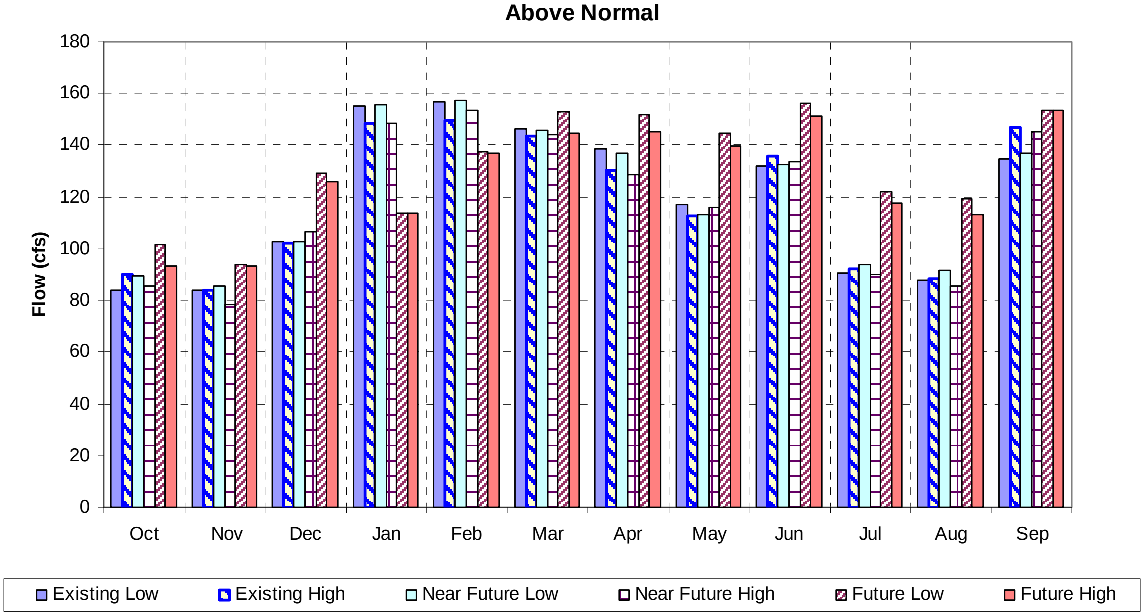

Figure A2-9 . Average above normal year (40-30-30 Classification) monthly North Bay Aqueduct diversions from the Delta.

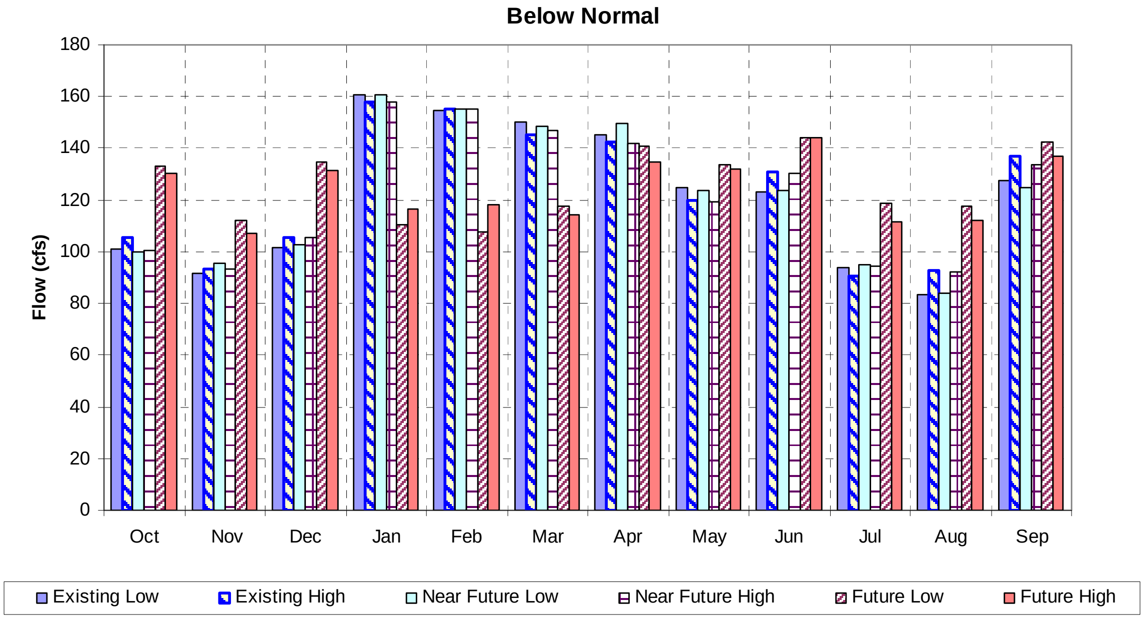

Figure A2-10 . Average below normal year (40-30-30 Classification) monthly North Bay Aqueduct diversions from the Delta.

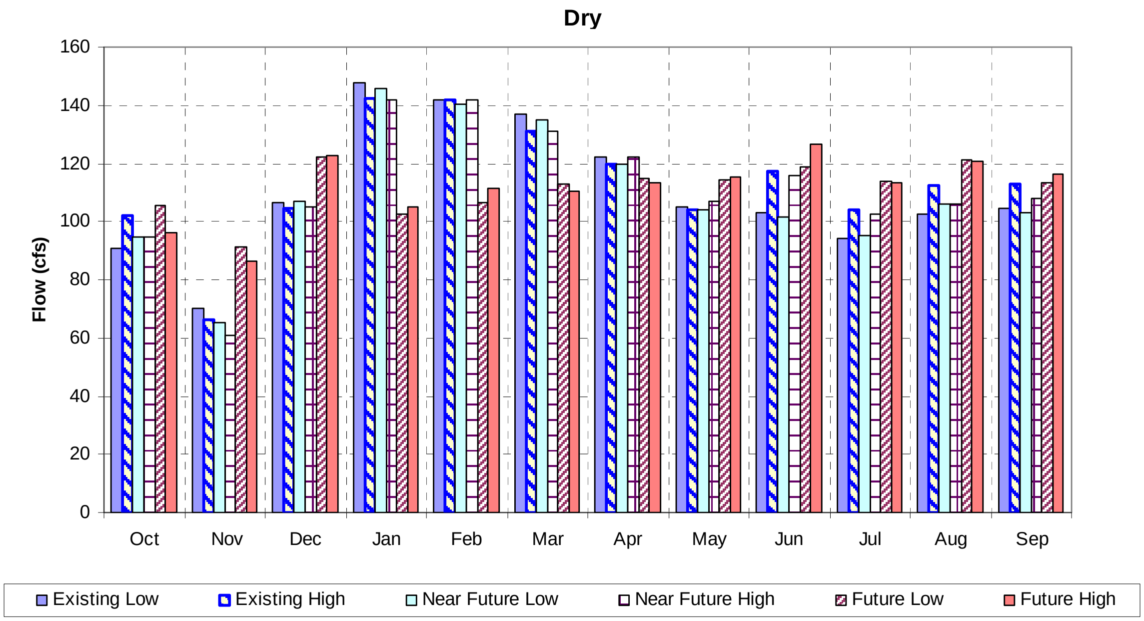

Figure A2-11. Average dry year (40-30-30 Classification) monthly North Bay Aqueduct diversions from the Delta.

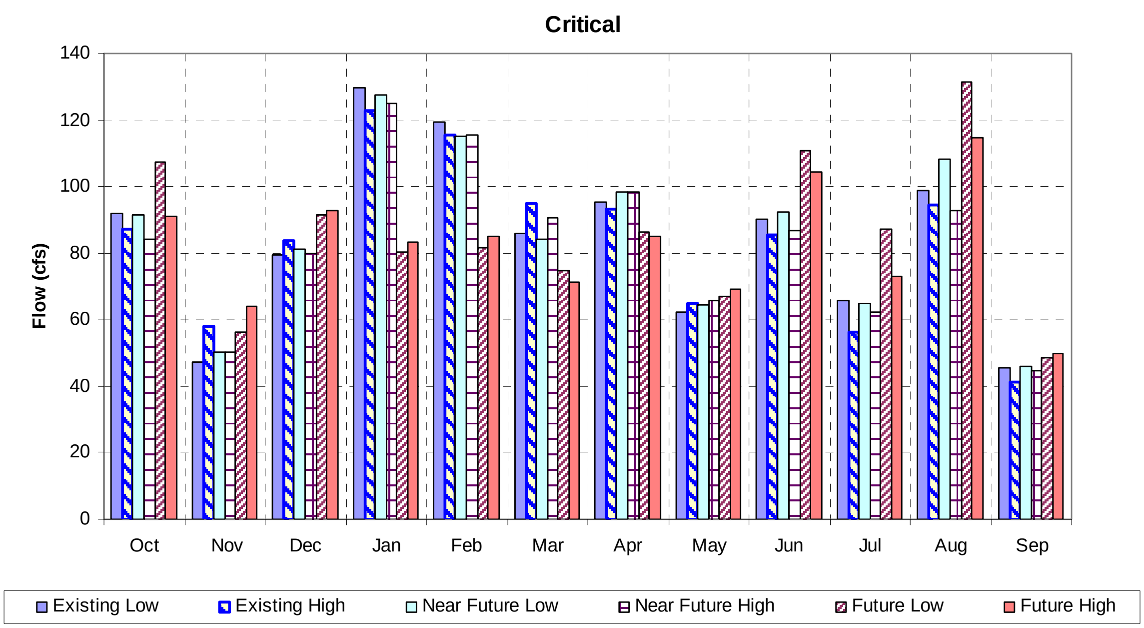

Figure A2-12. Average critical year (40-30-30 Classification) monthly North Bay Aqueduct diversions from the Delta.

Total Outflow

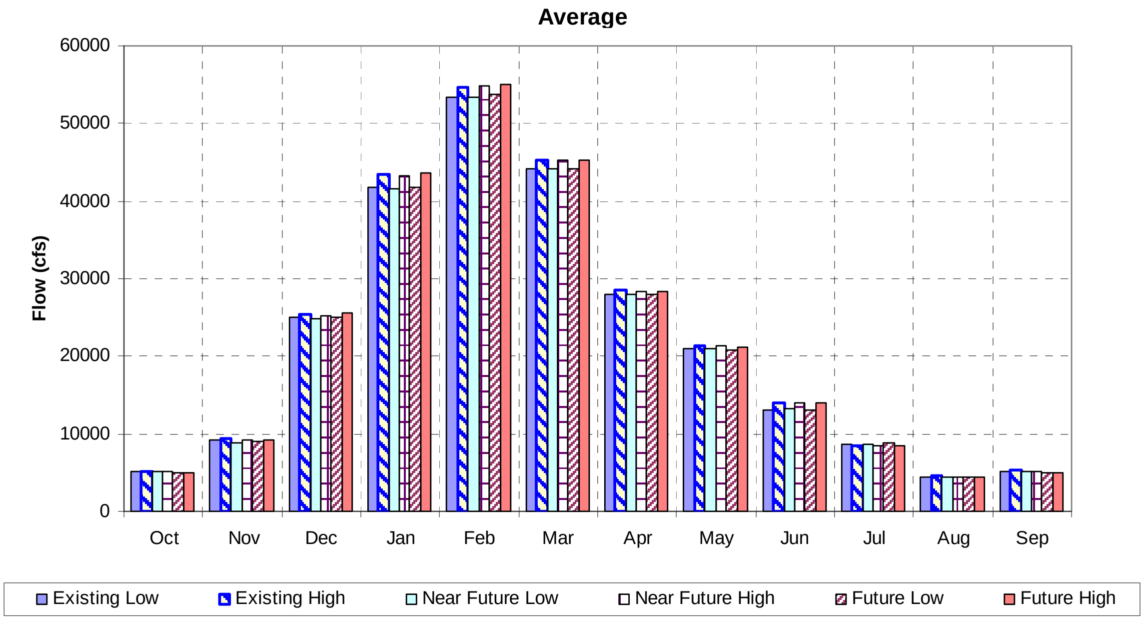

Figure A2-13. Average monthly total Delta outflow.

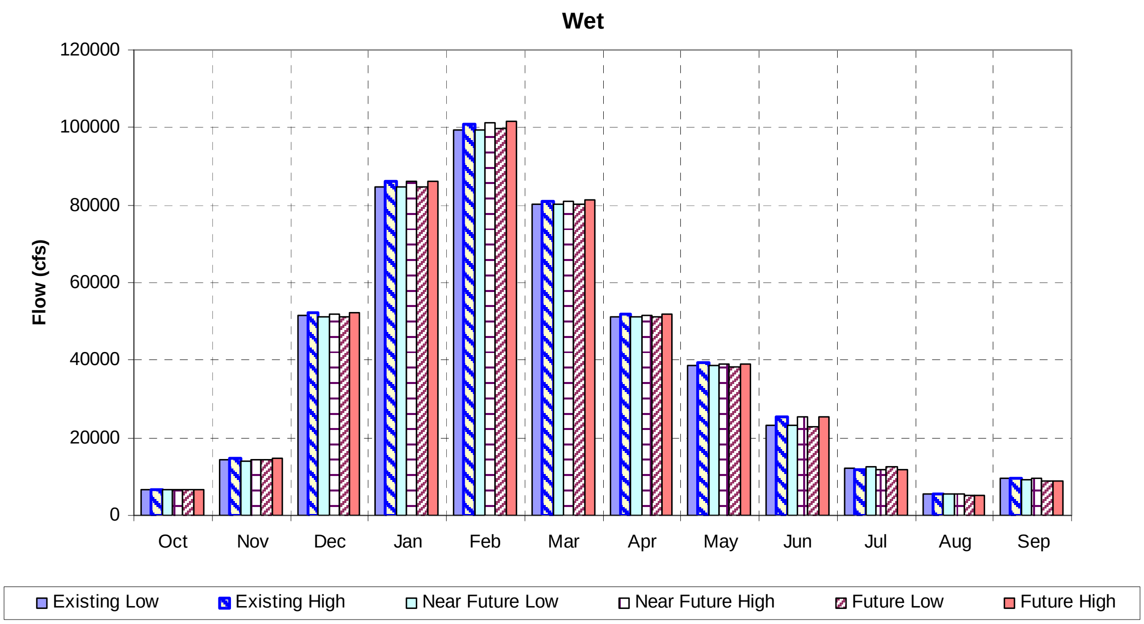

Figure A2-14. Average wet year (40-30-30Classification) monthly Delta outflow.

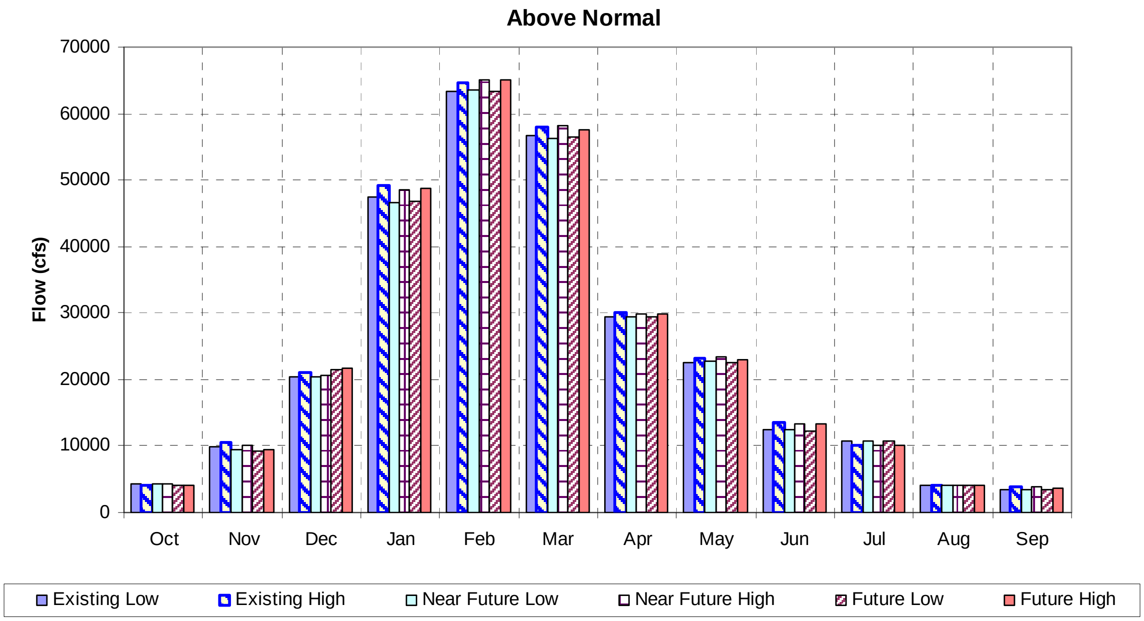

Figure A2-15. Average above normal year (40-30-30Classification) monthly Delta outflow.

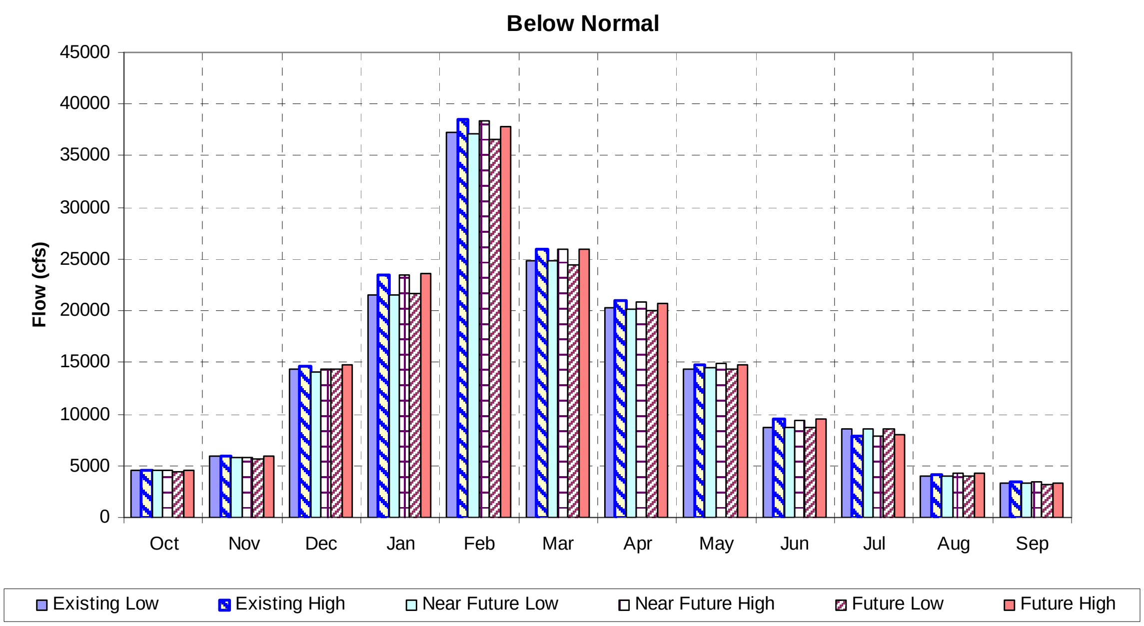

Figure A2-16 . Average below normal year (40-30-30Classification) monthly Delta outflow.

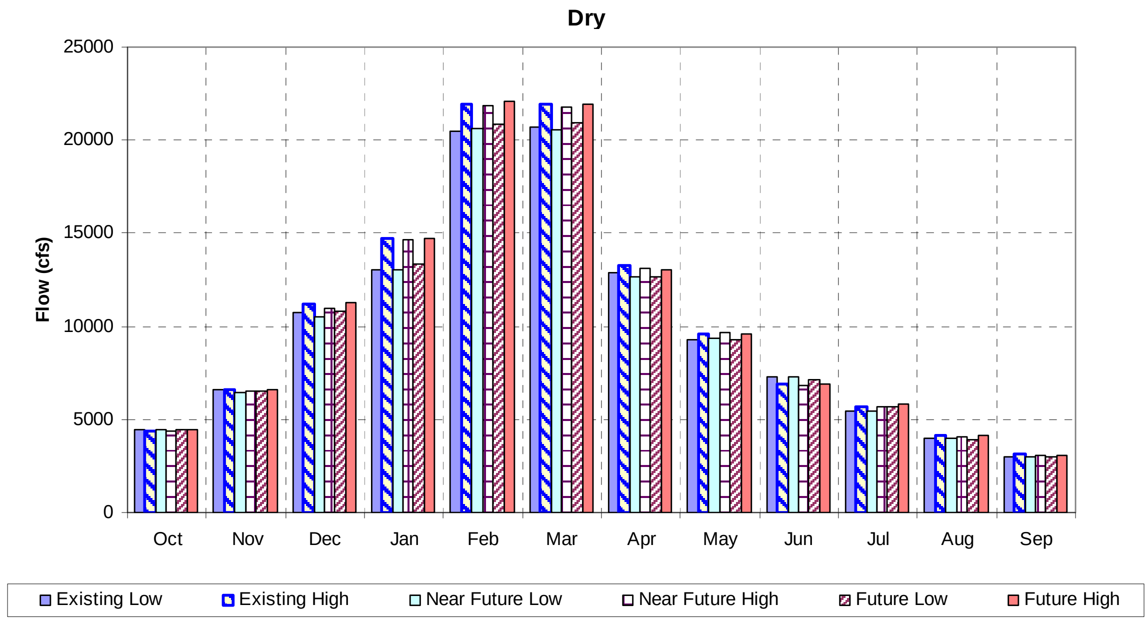

Figure A2-17.. Average dry year (40-30-30Classification) monthly Delta outflow.

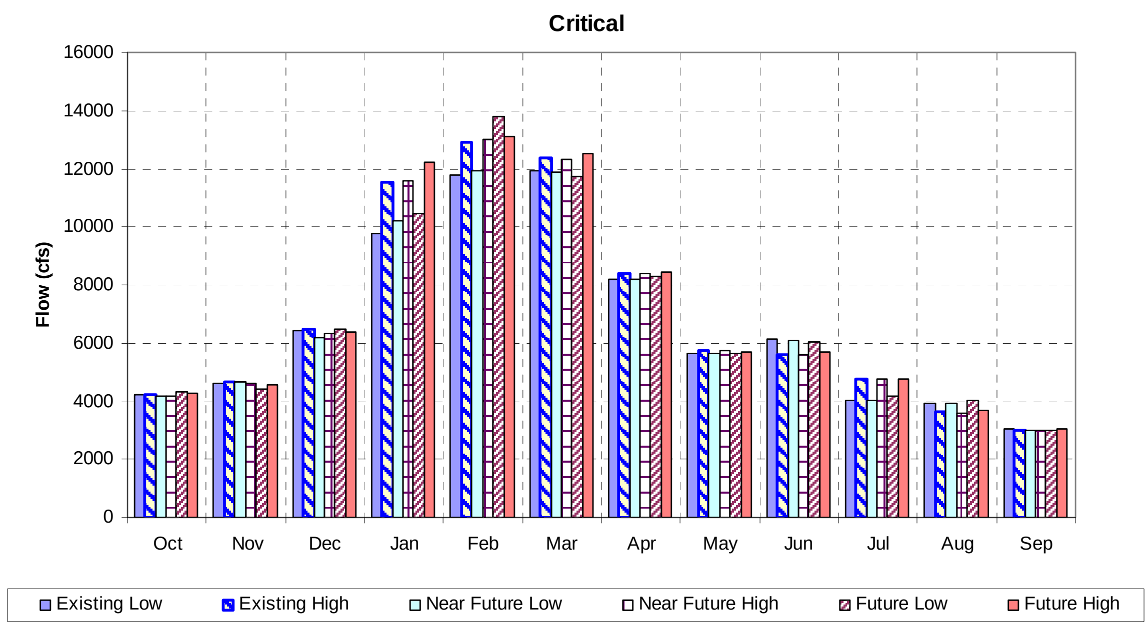

Figure A2-18 . Average critical year (40-30-30Classification) monthly Delta outflow.

Export/Inflow Ratio

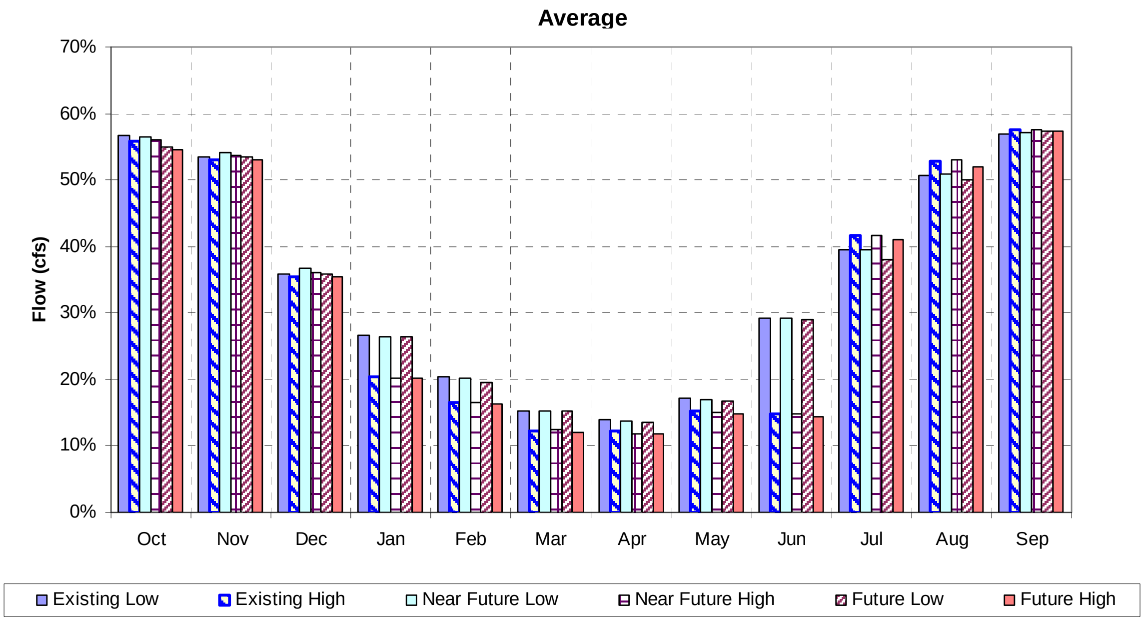

Figure A2-19. Average monthly export-to-inflow ratio.

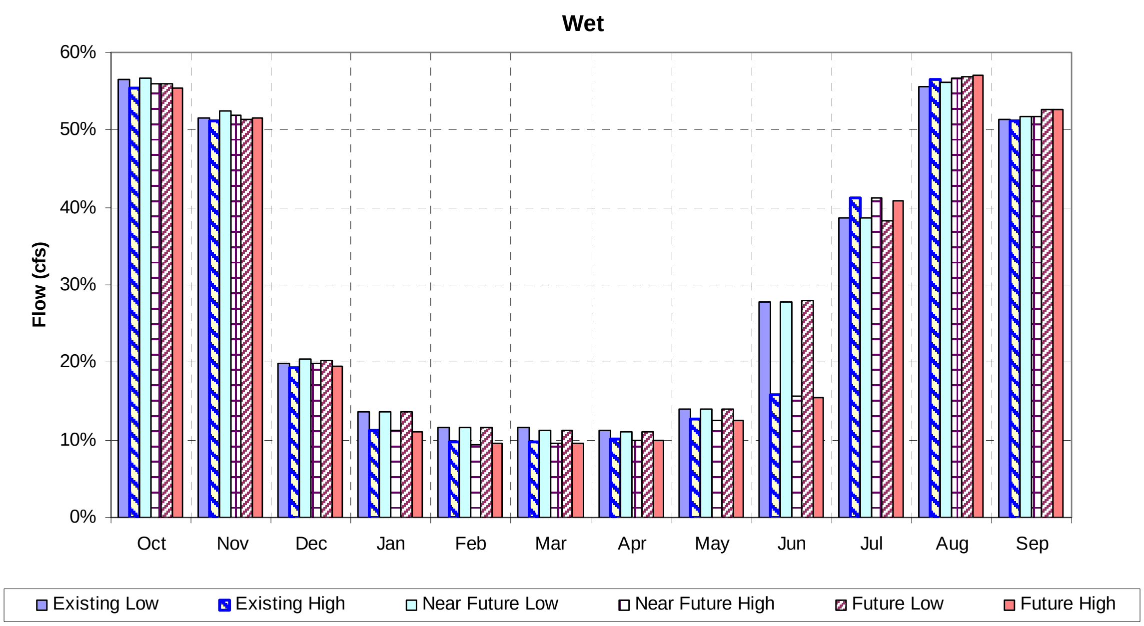

Figure A2-20 . Average wet year (40-30-30 Classification) monthly export-to-inflow ratio.

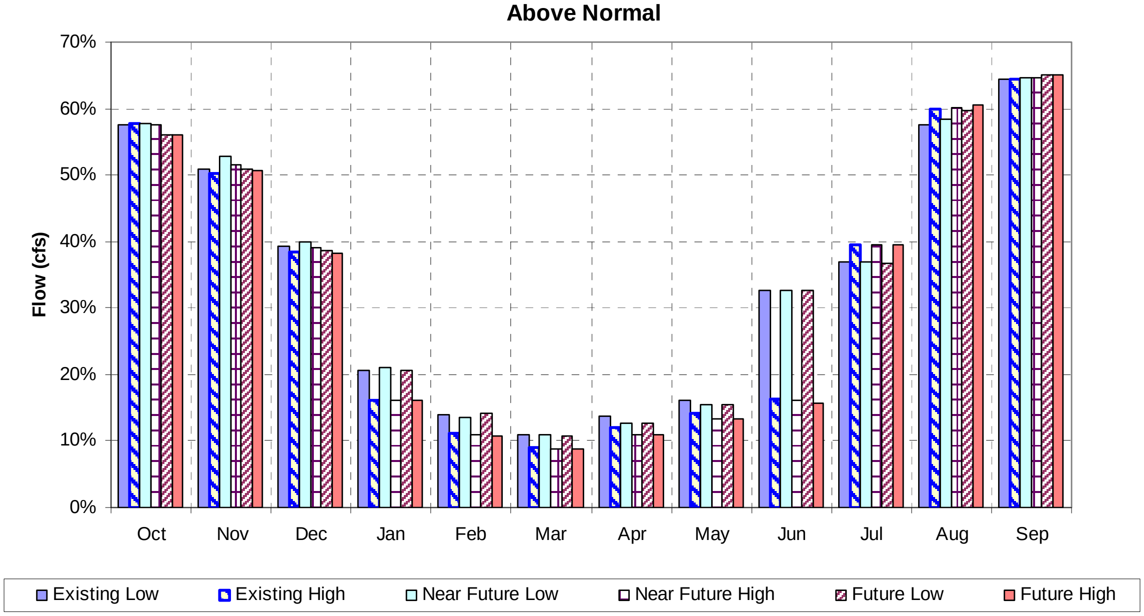

Figure A2-21. Average above normal year (40-30-30 Classification) monthly export-to-inflow ratio.

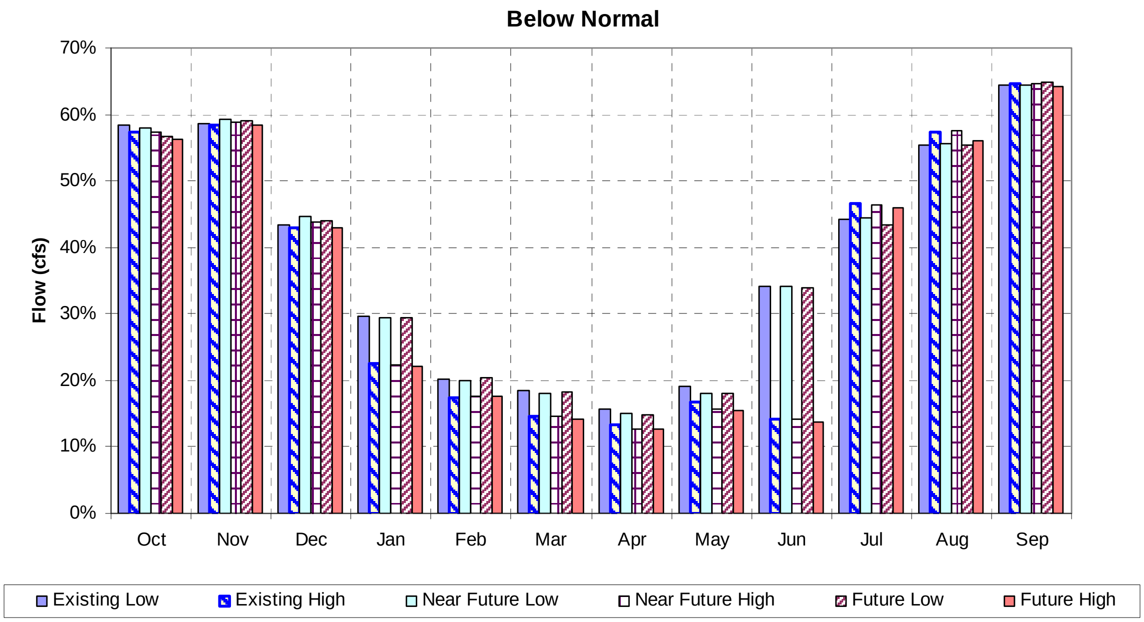

Figure A2-22 . Average below normal year (40-30-30 Classification) monthly export-to-inflow ratio.

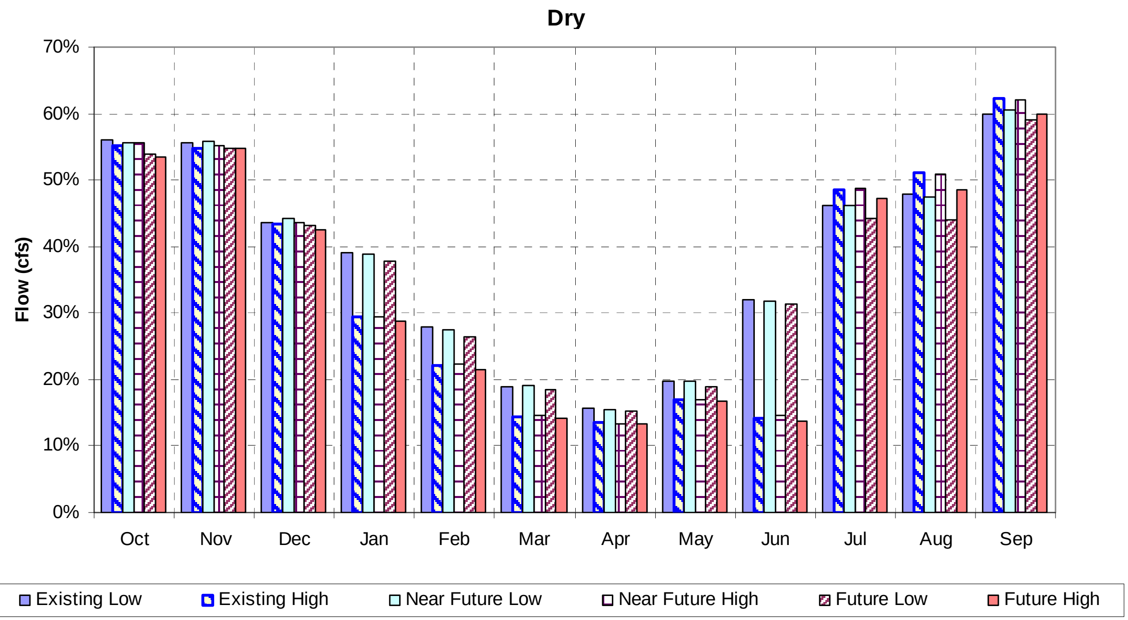

Figure A2-23 . Average dry year (40-30-30 Classification) monthly export-to-inflow ratio.

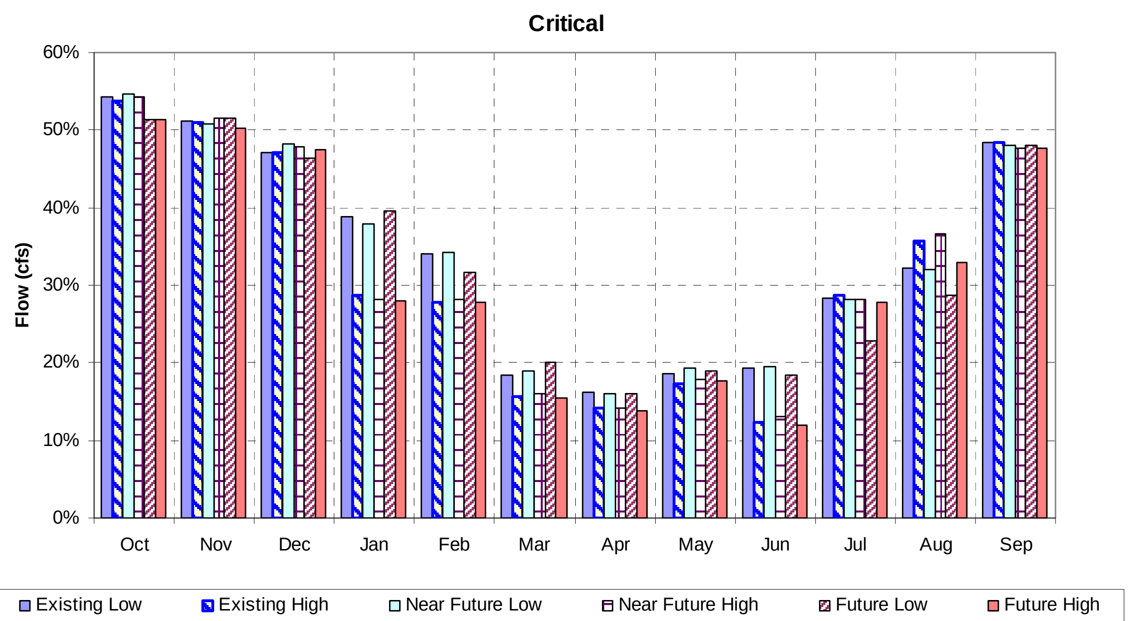

Figure A2-24. Average critical year (40-30-30 Classification) monthly export-to-inflow ratio.

APPENDIX 3

LONGFIN SMELT EFFECTS ANALYSIS

Analysis of the Magnitude and Effect of Incidental Take of Longfin Smelt by State Water Project Facilities in the Sacramento – San Joaquin Delta and San Francisco Bay

Table of Contents

Analysis of the Magnitude and Effect of Incidental Take of Longfin Smelt by State Water Project Facilities in the Sacramento – San Joaquin Delta and San Francisco Bay

1.0 Introduction

The California Department of Water Resources (DWR) has applied for a permit for the incidental take of longfin smelt (*Spirinchus thaleichthys*) pursuant to Fish and Game Code 2081(b)(c). Specific to the application are the requirements to determine the extent of take of longfin smelt by the project, the impact of the take on the species, and if granting a permit for incidental take will jeopardize the continued existence of longfin smelt. The following has been prepared to address these requirements with the most readily available, applicable information.

DWR provided California Department of Fish and Game (DFG) with a 2081 permit application that resulted in the comments identified below for each of the three subject application requirements:

EXTENT OF TAKE: Provide an analysis of whether and to what extent the project or activity could result in the taking of the species to be covered by the permit. Include a discussion of habitat impacts and the project activities that could cause take of covered species. Use a table or chart, if necessary, to display impacts of different aspects of the project. Attach results of field surveys and qualifications of individuals conducting surveys, if applicable.

> The analysis required by this section is intended to assist DFG in assessing whether and to what extent the Project could result in the taking of longfin smelt. This section should quantify the impact of the proposed Project on the species and its population. A description of historical State Water Project (SWP) salvage and known population estimates should be included from each facility. In addition, the amount of take associated with previously approved projects, as well as reasonably foreseeable projects, should also be described here (DFG 2008a).

A. IMPACT ON THE SPECIES: Present an analysis of the impacts of the proposed taking on the species. For example, will the project impact a significant share of the population? Does the project create a barrier that will isolate remaining populations from each other?

This section should evaluate the impact of the taking of longfin smelt by the proposed Project on the species and its population. The analysis should describe how much of the historic range of longfin smelt remains intact and how much of the historic range is no longer suitable to support the species. Range-wide maps of historic and extant populations relative to the proposed Project footprint would be helpful. This section should also describe the location of critical population densities or core populations of this species relative to the proposed Project's effect footprint and the impacts of the Project on those populations. This section should also include literature citations and footnotes, with generally unavailable references provided as attachments.

B. JEOPARDY: Present an analysis of whether issuance of the incidental take permit would jeopardize the continued existence of a species. This analysis shall include consideration of the species' capability to survive and reproduce, and any adverse impacts of the taking on those abilities in light of: 1) known population trends; 2) known threats to the species; and 3) reasonably foreseeable impacts on the species from other related projects and activities.

The analysis required by this section is intended to assist DFG in assessing whether the species will be in jeopardy as a result of Project implementation. This section should evaluate the impact of the proposed Project on the species-wide population and locally critical populations, and should describe how much of the historic range of longfin smelt remains intact and how much will be affected by Project operations. Impacts from all SWP facilities and other related projects or activities should be described in this section. In addition, take of longfin smelt likely to occur as a result of mitigation activities associated with implementation of other agency permits should be described and considered.

1.1 General Findings

SWP diversions may adversely affect longfin smelt directly by entrainment (i.e., non-volitional movement of fish due to the hydraulic effects of pumping that results in removal of the fish from its habitat) and indirectly by adversely modifying required habitats (e.g., by altering channel hydrodynamics, reducing freshwater outflow and shifting the location of suitable brackish water rearing habitat, and/or removing planktonic food organisms).

Longfin smelt are at greatest direct risk from water diversions at two critical times in their life cycle, first when larvae and juveniles when the young fish are in freshwater after they hatch (during late winter, spring and early summer) and then again as pre-spawning and spawning adults when the fish move up into freshwater areas of estuaries to spawn (during winter and early spring) (**Figure 1-1**).

1.1.1 Project Effects

Several factors associated with operations of the SWP may be related to the decline of longfin smelt and may continue to be impediments to their recovery, including:

1. Longfin smelt abundance has been correlated with to freshwater outflow. SWP operations increase freshwater outflow during some times of the year and reduces it in others. However, the abundance/outflow relationship appears to have declined in recent years for reasons which are still unclear.
2. Longfin smelt are entrained by water diversions, including diversions in the south Delta operated by the SWP and the Central Valley Project (CVP). Some entrained longfin smelt are 'salvaged' by the SWP and CVP from the entrained flow and returned alive to the Delta, but most are diverted into aqueducts and lost. Continued entrainment and loss at historical levels may impair longfin smelt recovery.

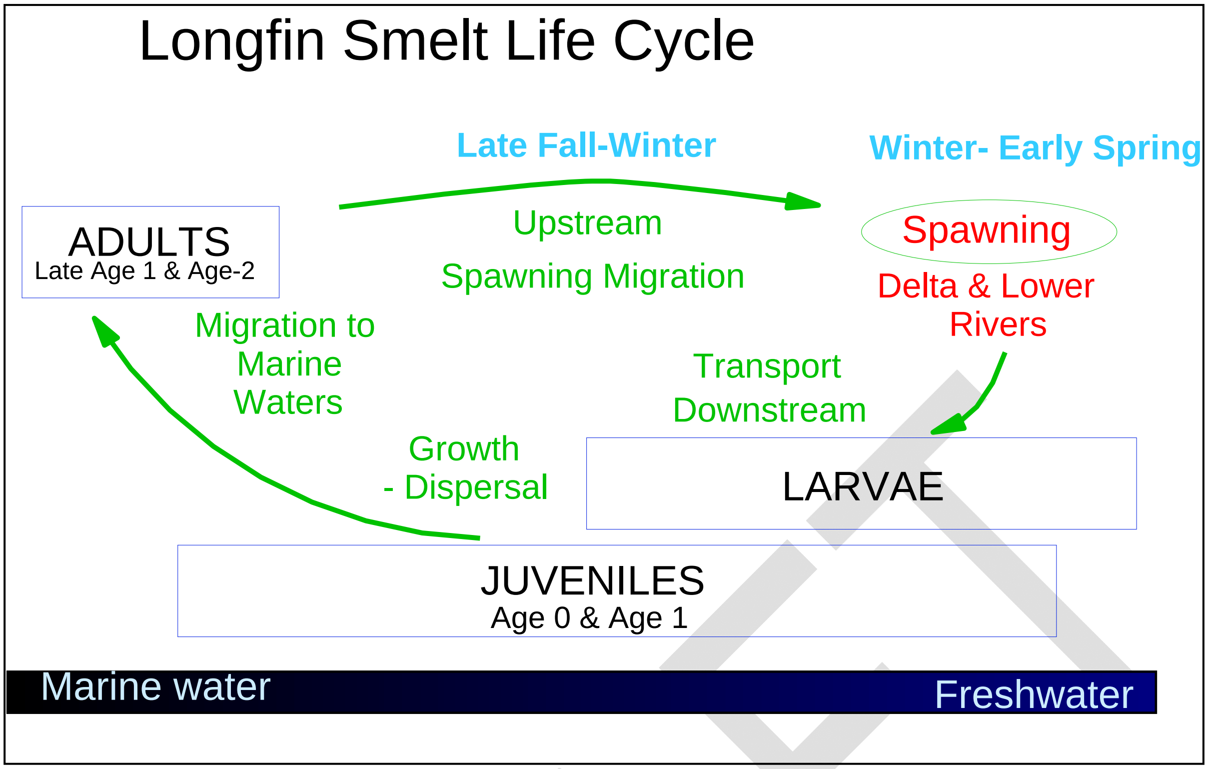

Figure 1-1. Lonfin Smelt Life Cycle (Baxter 2008, unpublished)

3. Operations of the SWP and CVP alter the character and position of the salinity gradient. When these operations increase Suisun Bay salinity during longfin smelt spawning migration, longfin smelt staging locations and spawning shifts upstream where they are subject to entrainment by State Water Project and the Central Valley Project diversions and other diversions. Continuing increased Suisun Bay salinity coupled with entrainment and loss at diversions may impair longfin smelt recovery

Similarly, the following SWP-related actions may have population-level benefits for longfin smelt:

1. Reduce entrainment and loss of adult, juvenile, and larval longfin smelt at the SWP and CVP diversions from the south Sacramento-San Joaquin Delta.
2. Reduce entrainment and loss of adult, juvenile, and larval longfin smelt at agricultural diversions in the Sacramento-San Joaquin Delta.
3. Modify operations of the SWP and CVP to improve and/or expand open-water habitat for longfin smelt.

In addition, longfin smelt recovery may depend in part upon a number of non-SWP/CVP-related actions including:

- Low numbers of spawning longfin smelt may result in reproductive (year-class) failure and increase the likelihood that a catastrophic event could severely affect the population.

- Longfin smelt habitat — including nutrient inputs, prevalence of exotic species, and food items — has changed. The reduction in abundance of the food items *Eurytemora affinis, Neomysis mercedis*, and *Hyperacanthomysis longirostris*, may be a threat to the persistence and recovery of longfin smelt.
- Alien invertebrate species have been introduced into the San Francisco Estuary and their presence has led to distinct changes in the Estuary's biota. Through competition with longfin smelt, these alien species may inhibit longfin smelt recovery.
- Some water samples from discrete locations in the Sacramento-San Joaquin Delta and Suisun Bay were toxic to standard aquatic test organisms in laboratory trials. Longfin smelt were present in the vicinity of these locations and may have been adversely affected by toxicity of the water. Continuing water pollution may be a threat to longfin smelt recovery.
- Predation on longfin smelt by managed fishes may be a threat to longfin smelt recovery. Piscivorous striped bass and managed warm-water fishes (e.g., black bass) co-occur — to varying degrees — in space and time with longfin smelt. Piscivorous striped bass number in the millions and are known to eat smelts, salmonids, striped bass, and many other fishes. Black bass are considered abundant, their numbers have increased since the 1980's, and they are known to eat many fishes. Little is known about the populations of other warm-water fishes, but they are considered abundant. Continuing predation on longfin smelt by managed fishes may be a threat to longfin smelt recovery.
- Dredging and sand mining in the San Francisco Estuary could be a threat to longfin smelt recovery. Little is known on the impacts of these operations to longfin smelt, but operations conducted in freshwater could entrain adults, eggs, and larvae during winter spawning and incubation.
- A small fishery for bay shrimp in San Francisco Estuary sometimes takes longfin smelt as by-catch. Historical assessments of juvenile striped bass mortality in the fishery and longfin smelt catches by the fishery suggest that the fishery may hinder longfin smelt recovery.

Because there is not yet a quantitative basis for estimating the benefits of any given action(s), assuring longfin smelt persistence and recovery during the foreseeable future will continue to involve implementing management measures and evaluating their success empirically.

2.0 Analytical Framework

2.1 Status of the Longfin Smelt/Environmental Baseline

The following analysis relies on four components to support the jeopardy determination for the longfin smelt: (1) the *Status of the Species*, which evaluates the longfin smelt's range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the longfin smelt in the action area, the factors responsible for that condition, and the role of the action area in the longfin smelt's survival and recovery; in this case the action area covers the entire range of the longfin smelt within the San Francisco Bay-Sacramento San Joaquin Delta; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed action and the effects of any interrelated or interdependent activities on the longfin smelt.

The area of analysis covers the entire range of the longfin smelt within the Sacramento San Joaquin Delta/San Francisco Bay, and the Status of the Species and Environmental Baseline.

On August 14, 2007, the Fish and Game Commission (FGC) received a petition from The Bay Institute, Center for Biological Diversity, and Natural Resources Defense Council to use emergency rulemaking to list longfin smelt as an endangered species under the California Endangered Species Act (CESA). On August 21, 2007, the FGC referred the petition to the Department of Fish and Game (DFG) for evaluation. On October 11, 2007, the FGC denied the request for an emergency action but continued under a standard rulemaking procedure. On February 7, 2008, the FGC accepted the petition for consideration and noticed their action in the February 29, 2008 California Regulatory Notice Register. (Fish & G. Code § 2074.2.) CESA requires that within twelve months of the publication of the notice of a petition's acceptance for consideration the DFG shall provide a written report regarding the status of the species. (Fish & G. Code § 2074.6.)

The longfin smelt was one of eight fish species addressed in the *Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes* (USFWS 1995). The longfin smelt is endemic to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta) in California, and is restricted to the area from San Pablo Bay upstream through the Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties (Moyle 2002). Their range extends from San Pablo Bay upstream to Verona on the Sacramento River and Mossdale on the San Joaquin River. The longfin smelt was formerly considered to be one of the most common pelagic fish in the upper Sacramento-San Joaquin Estuary.

2.1.1 Extent of Take

The SWP can affect take of longfin smelt directly by entraining longfin smelt into SWP facilities and indirectly by influencing habitat conditions that support the various life stages of longfin smelt that occur within the area of influence. These effects are typically described using indicators of hydrodynamic and related physical and biological conditions including: (1) X2; (2) Old and Middle River flows (OMR); (3) Delta Outflow; and (4) entrainment (salvage).

2.1.2 Longfin Smelt Species/Population Description

Longfin smelt is a small (~90-110 mm standard length at maturity), semelparous, pelagic fish that often has a 2-year life cycle (Moulton 1974, *as cited in* Rosenfield and Baxter 2007). Longfin smelt are euryhaline, but prefer salinities in the range of 15-30 ppt after the early juvenile stages (Baxter et al. 1999, *as cited in* Moyle 2002). Preferred summer water temperatures of longfin smelt appear to be around 16-18°C, but they can reportedly tolerate water temperatures as warm as 20°C (Moyle 2002). Adults and juveniles are often found in the open waters of estuaries, mostly in the middle or at the bottom of the water column (Moyle 2002).

Longfin smelt populations in California have been known to historically occur in the San Francisco Estuary, Humboldt Bay, the Eel River estuary, and the Klamath River estuary (Moyle 2002). The San Francisco Estuary longfin smelt population is the southernmost within the species' range and is the largest known population in California (Moyle 2002).

2.1.3 Overview of Longfin Smelt's Life Cycle

Longfin smelt are broadly distributed in the San Francisco Estuary, both temporally and spatially (Rosenfield and Baxter 2007). As described by Rosenfield and Baxter (2007), the San Francisco Estuary includes (1) "the Delta," a broad network of tidally influenced channels formed by the confluence of the Sacramento and San Joaquin rivers; (2) open water embayments downstream from the Delta and inland from the Golden Gate Bridge; and (3) large brackish marshes. The longfin smelt life cycle begins with spawning in the Delta and lower Sacramento and San Joaquin Rivers (winter and spring), followed by downstream transport of the larvae, juvenile dispersal and migration to marine waters, and an upstream spawning migration by yearlings during late fall and winter (see **Figure 2-1**, below).

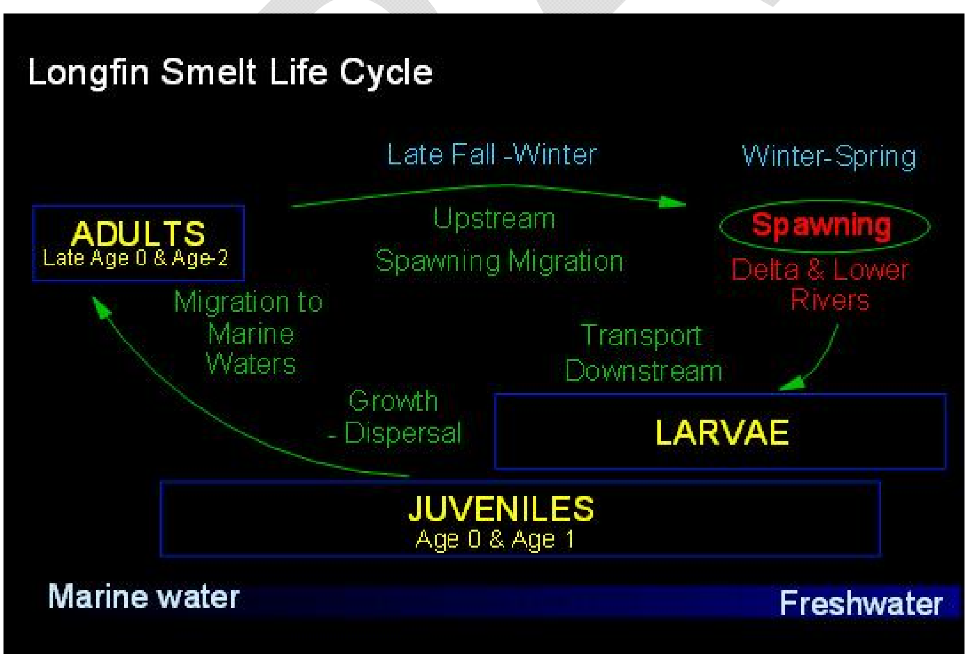

Figure 2-1. Longfin Smelt Life Cycle
Source: Baxter 2008, unpublished

2.1.4 Longfin Smelt Life-History and Habitat Requirements

2.1.4.1 Spawning

Longfin smelt spawning may occur from as early as November through as late as June, but primarily occurs from February through April. Spawning reportedly occurs in freshwater, over sandy or gravel substrates, rocks and aquatic plants (Emmet et al. 1991, Wang 1986, 1991, *as cited in* Moyle 2002). Spawning appears to primarily occur downstream of Rio Vista on the Sacramento River and Medford Island on the San Joaquin River (Wang 1986, 1991, *as cited in* Moyle 2002) (See Figure 2, below). The downstream extent of longfin smelt spawning reportedly occurs in upper Suisun Bay around Pittsburg and Montezuma Slough in Suisun Marsh (Wang 1986, 1991, *as cited in* Moyle 2002). However, some spawning may also occur at the southern tip of South San Francisco Bay (see **Figure 2-2**, below). Most smelt diet after spawning. A few smelt, mostly females, live another year, although it is not certain whether or not they spawned previously (Moyle 2002).

Figure 2-2. Longfin Smelt Spawning Areas
Source: Baxter 2008, unpublished

2.1.4.2 Larvae/Juveniles

Longfin smelt embryos hatch in approximately 40 days (at 7°C) (Dryfoos 1965, *as cited in* Moyle 2002). Larvae quickly move into the upper part of the water column and are transported downstream into more brackish areas of the estuary (Moyle 2002). Post-larval longfin smelt are reportedly associated with deep-water habitats (Rosenfield and Baxter 2007). Larvae are usually most abundant in the water column from January through April (DFG unpublished, *as cited in* Reclamation 2008). Metamorphosis into juveniles probably begins 30-60 days after hatching, depending on water temperature (Emmett et al. 1991, *as cited in* Moyle 2002).

During years when high outflows occur when larvae are being transported downstream, most larvae are transported to Suisun and San Pablo bays; during years with lower outflow, larvae are transported into the western Delta and Suisun Bay (Baxter 2000, Baxter et al. 1999, *as cited in* Moyle 2002) (see **Figures 2-3** and **2-4**, below). The center of distribution of longfin smelt larvae varies with outflow conditions and is closely associated with the low-salinity zone (LSZ, which can be indexed as X2); the center of distribution is consistently seaward of X2 (Dege and Brown 2004, *as cited in* Reclamation 2008).

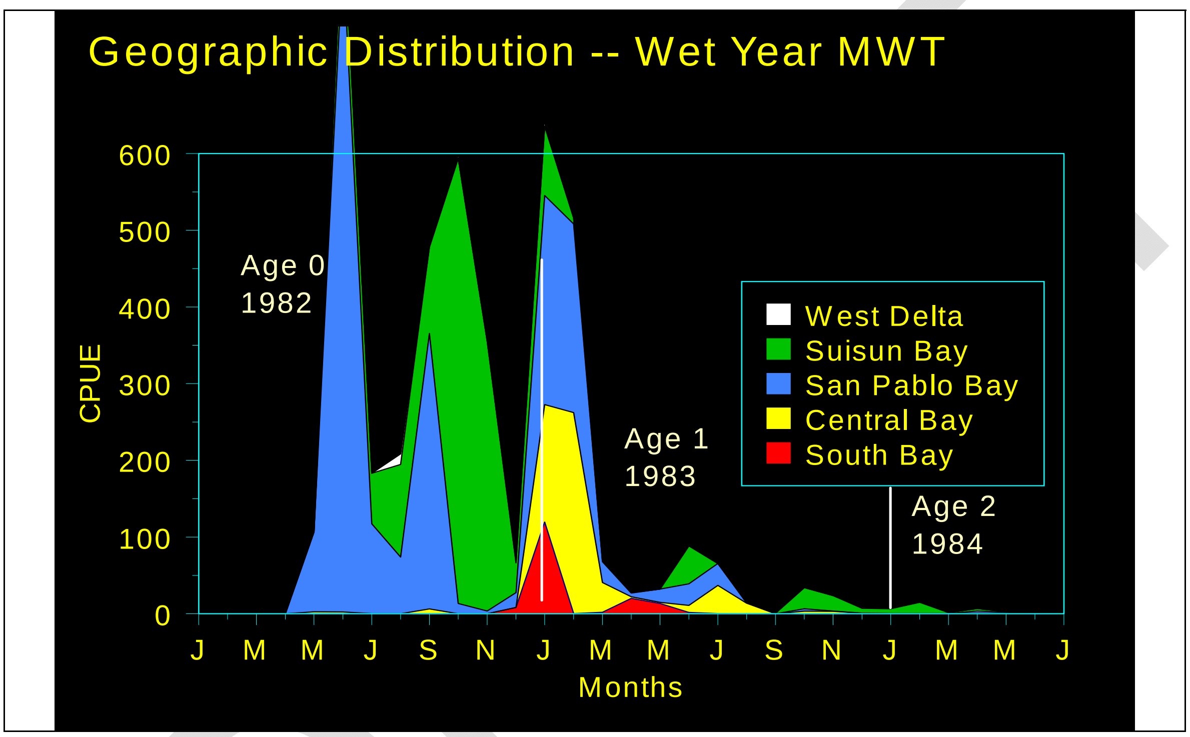

Figure 2-3. Geographic Distribution of Longfin Smelt during Wet Years (1982-1984)
Source: Baxter 2008, unpublished

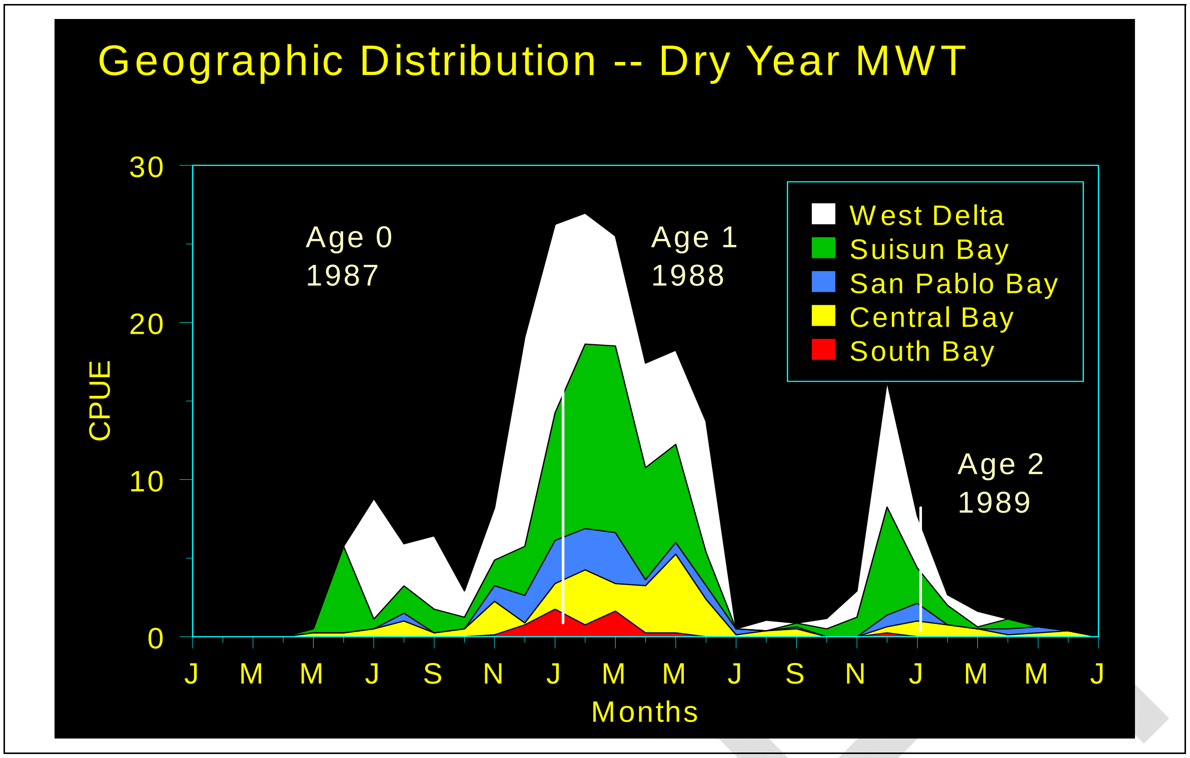

Figure 2-4. Geographic Distribution of Longfin Smelt during Dry Years (1987-1989)
Source: Baxter 2008, unpublished

2.1.4.3 Adults

In the San Francisco Estuary, the center of the longfin smelt population's distribution gradually moves down the estuary during the summer. During most years adults concentrate in San Pablo Bay during April-June and become more dispersed during late summer (many moving into central San Francisco Bay) (Moyle 2002). Longfin smelt also are often found in the Gulf of the Farallones, just outside of the Golden Gate Bridge, usually only during wet years (Baxter 2000, Baxter et al. 1999, *as cited in* Moyle 2002). The concentration of longfin smelt in deepwater habitats, combined with their migration into marine waters during the summer suggests that longfin smelt may be relatively intolerant of the warmer waters that occur in the estuary. The population gradually moves upstream during fall and winter to spawn. The exact distribution pattern of longfin smelt varies from year to year. During winter months, high outflows may push yearlings back into San Francisco Bay, whereas during drought years they may concentrate in Suisun Bay (Armor and Herrgesell 1985, *as cited in* Moyle 2002).

2.1.5 Longfin Smelt Distribution and Population Dynamics/Abundance Trends

2.1.5.1 Historical Population Distribution

The historical distribution of the San Francisco Estuary longfin smelt population extended from the lower Sacramento and San Joaquin Rivers to the San Francisco Bay (including the Suisun, San Pablo, Central and South embayments and Suisun Marsh) and into the Gulf of Farallones, just outside of the Golden Gate (see **Figure 2-5**, below)

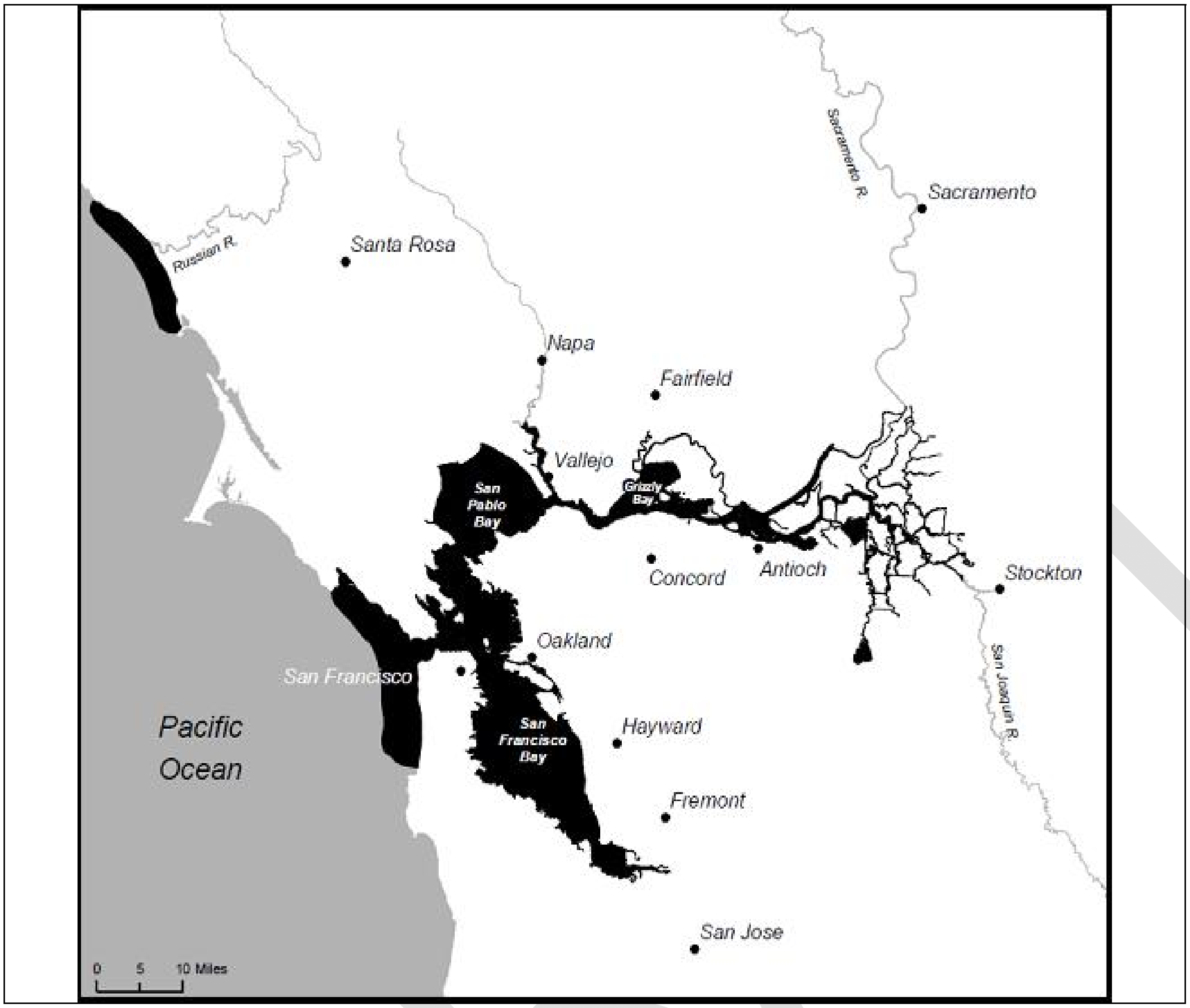

Figure 2-5. Historical Longfin Smelt Population Distribution in the San Francisco Estuary Source: The Bay Institute et al. 2007

2.1.5.2 Current Population Distribution

The longfin smelt's distribution in the San Francisco Estuary is not expected to differ from its historical distribution. Rosenfield and Baxter (2007) did not find any evidence that longfin smelt were consistently absent from particular sites in the estuary where they had occurred prior to the 1987-1994 drought. However, the annual geographic distribution of particular life-stages in the estuary does change with conditions such as Delta outflow and X2 position, as discussed above.

2.1.5.3 Population Dynamics/Abundance Trends

In the San Francisco Estuary longfin smelt historically demonstrated wide fluctuations in abundance, reflecting actual population trends and their concentration in areas during some years that were not sampled (Moyle 2002). Numbers of longfin smelt typically reached their lowest levels during drought years, but have generally quickly recovered when adequate winter and spring flows returned (Moyle 2002).

Various studies have identified relationships between longfin smelt population dynamics and physical or biological conditions of the estuary, such as a positive relationship between longfin smelt abundance and freshwater flow through the estuary (Stevens and Miller 983; Jassby et al. 1995; Kimmerer 2002b; *as cited in* Rosenfield and Baxter 2007).

The size of the longfin smelt population in the San Francisco Estuary is measured by indices of abundance generated from different sampling programs, including the Fall Midwater Trawl (FMWT), the Bay Study's Midwater Trawl (MWT) and Otter Trawl (OT), and the 20mm Survey. Rosenfield and Baxter (2007) studied historical trends in annual longfin smelt abundances using indices from the FMWT and the Bay Study's MWT, in addition to CPUE data from the Suisun Marsh Survey, and found that significant declines occurred in abundances of longfin smelt juveniles (age-class 1) and prespawning adults (age-class 2). The decline in age-class 2 adults in the FMWT and Suisun Marsh data sets was greater than would be expected based on the decline in juvenile abundance, suggesting that survival between age-classes 1 and 2 has declined between the pre- and post-drought periods (Rosenfield and Baxter 2007). In addition, the 2007 FWMT index was the lowest recorded (13) since the survey began in 1967 (Reclamation 2008) (see **Figure 2-6**, below). The recent decline in longfin smelt numbers and those of other pelagic Delta fish species has become known as the Pelagic Organism Decline (Sommer et al. 2007, *as cited in* Reclamation 2008).

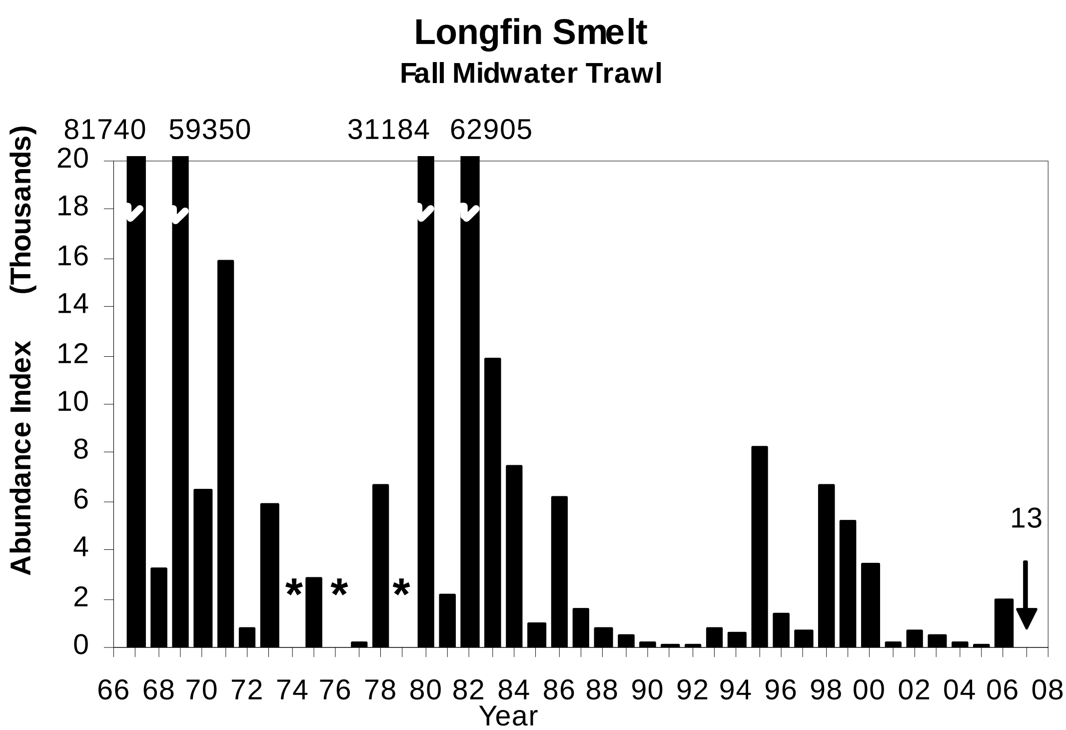

Figure 2-6. Longfin Smelt FMWT Abundance Indices
(* Years that have been omitted coincide with no data or incomplete sampling events)
Source: Baxter 2008, unpublished

3.0 Project-related Factors Potentially Affecting Longfin Smelt

The proposed project is DWR's on-going and long-term operation of the State Water Project (SWP) in the manner consistent with the protection and conservation of the longfin smelt (*Spirincus thaleichthys*) in compliance with the California Endangered Species Act (CESA) as authorized by the California Department of Fish and Game (DFG) through issuance of a permit for take of longfin smelt pursuant to Section 2081 of CESA (California Fish and Game Code section 2081). The action consists of operation of SWP facilities in accordance with certain actions consistent with the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion of the Operating Criteria and Plan for the Coordinated Operations of the Central Valley Project and State Water Project (USFWS 2008). The action includes operation of SWP facilities from December through June to protect adult longfin smelt migration and spawning and larvae and juvenile rearing. The protection of longfin smelt is achieved through operations undertaken during the same period to protect delta smelt which are sufficient for the protection of longfin smelt because of included adaptive management provisions and the substantial overlap in timing and distribution of these species in the Delta. The specific operations proposed for protection of longfin smelt are described in detail below in the section on Proposed State Water Project Operations for Protection of Longfin Smelt (page 27). Additionally, monitoring measures are described in the section on Minimization Measures for SWP Operations.

DWR is not proposing any additional actions for protection of longfin smelt beyond actions already in place for protection of delta smelt. DWR believes these actions are sufficiently robust and effective in protecting longfin smelt from the effects of SWP operations to authorize take. The actions include a weekly adaptive management process for DFG to provide input on SWP operations for the protection of longfin smelt. If DFG determines that additional protective actions for longfin smelt are needed to approve take authorization under CESA Section 2081, DWR may need to implement additional actions as prescribed. At this time, DWR cannot know if DFG will prescribe additional actions necessary for authorizing take of longfin smelt under section 2081. If any additional protective actions are prescribed and if these actions have the potential to impact the environmental, DWR will undertake additional environmental review as required under CEQA.

Under the proposed project, DWR will continue to deliver SWP water to the SWP contractors within all State and federal environmental regulations. The SWP long-term water supply contracts between DWR and its water contractors define how DWR will, among other provisions, allocate available water supply and costs to its SWP contractors. Under the contracts, as long as regulatory and hydrologic conditions permit, DWR will pump available water from the Delta to meet contractor and operational needs. Exports of SWP water allocated under the long-term water supply contracts, however, must be exported in conformance with SWP water right permits, U.S. Army Corps of Engineers (Corps) permits, State Water Resources Control Board (SWRCB) water quality regulations, Endangered Species Act biological opinions, and any other laws and regulations. Therefore, the proposed project will not result in Delta diversions at the SWP facilities above levels permitted under these regulatory constraints at the specific time of diversion.

3.1 Method of Analysis

This CEQA Initial Study/Negative Declaration uses a modeling approach to define the changes in water supply that can occur due to implementation of operational criteria on the SWP. SWP operations are typically described using models to approximate conditions resulting from application of the various requirements. Projected conditions include water supply and various attributes of the areas potentially affected by the operations, including aquatic habitat and water quality constituents. The requirements are defined as a collection of regulatory triggers that operate under varying conditions (e.g., water availability, fish population status). The proposed project or actions are generally described as a range of options identified by modeling the effects of various triggers on the targeted regulatory conditions within a range of historic hydrology. The actual real-time actions are those defined by a process initiated by regulatory-based triggers, informed by real time data collection and evaluation, modeling, and agency coordination. The modeling used in this document is an approach to approximate what could happen in real time under the various conditions based on historical data.

The following sections describe the SWP facilities and operations, and the requirements and processes that collectively define the proposed project or action. The environmental analysis consists of evaluating whether the operations of these facilities to protect longfin smelt will result in a significant effect on the environment. This CEQA document is not evaluating the whole SWP facilities and operations as those have been the subject of past or concurrent environmental review which has resulted in the current project description and operations.

3.2 State Water Project

DWR holds contracts with 29 public agencies in Northern, Central, and Southern California for water supplies from the SWP. Water stored in the Oroville facilities, along with excess water available in the Sacramento-San Joaquin Delta is captured in the Delta and conveyed through several facilities to SWP contractors.

The SWP is operated to provide flood control and water for agricultural, municipal, industrial, recreational, and environmental purposes. Water is conserved in Oroville Reservoir and released to serve three Feather River area contractors and two contractors served from the North Bay Aqueduct, and to be pumped at the Harvey O. Banks Pumping Plant (Banks) in the Delta and delivered to the remaining 24 contractors in the SWP service areas south of the Delta. In addition to pumping water released from Oroville Reservoir, the Banks pumps water from other sources entering the Delta.

3.2.1 State Water Project Delta Facilities

3.2.1.1 North Bay Aqueduct Intake at Barker Slough

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct (NBA) for delivery in Napa and Solano Counties. Maximum pumping capacity is 175 cubic feet per second (cfs) (pipeline capacity). During the past few years, daily pumping rates have ranged between 0 and 140 cfs. The current maximum pumping rate is 140 cfs because an additional pump is required to be installed to reach 175 cfs. In addition, growth of biofilm in a portion of the pipeline is also limiting the NBA ability to reach its full capacity.

The NBA intake is located approximately 10 miles from the main stem Sacramento River at the end of Barker Slough. Per salmon screening criteria, each of the ten NBA pump bays is individually screened with a positive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch. This configuration is designed to exclude fish approximately one inch or larger from being entrained. The bays tied to the two smaller units have an approach velocity of about 0.2 feet per second (ft/s). The larger units were designed for a 0.5 ft/s approach velocity, but actual approach velocity is about 0.44 ft/s. The screens are routinely cleaned to prevent excessive head loss, thereby minimizing increased localized approach velocities.

Delta smelt monitoring was required at Barker Slough under the March 6, 1995 Operating Criteria and Plan (OCAP) BO. Starting in 1995, monitoring was required every other day at three sites from mid- February through mid-July, when delta smelt may be present and continued monitoring was stopped in 2005. As part of the Interagency Ecological Program (IEP), DWR has contracted with the DFG to conduct the required monitoring each year since the biological opinion was issued. Details about the survey and data are available on DFG's website (http://www.delta.dfg.ca.gov/data/NBA).

Beginning in 2008, the NBA larval sampling was replaced by an expanded 20-mm survey (described at http://www.delta.dfg.ca.gov/data/20mm) that has proven to be fairly effective at tracking delta smelt distribution and reducing entrainment. The expanded survey covers all existing 20-mm stations, in addition to a new suite of stations near the NBA. The expanded survey also has an earlier seasonal start and stop date to focus on the presence of larvae in the Delta. The gear type was a surface boom tow, as opposed to oblique sled tows that were traditionally used to sample larval fishes in the San Francisco Estuary. These surveys also collect information on longfin smelt.

3.2.2 Delta Field Division

SWP facilities in the southern Delta include Clifton Court Forebay (CCF), John E. Skinner Delta Fish Protective Facility (Skinner Fish Facility), and the Banks Pumping Plant. CCF is a 31,000 AF reservoir located in the southwestern edge of the Delta, about ten miles northwest of Tracy. CCF provides storage for off-peak pumping, moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels, and collects sediment before it enters the California Aqueduct (CA). Diversions from Old River into CCF are regulated by five radial gates.

The Skinner Fish Facility is located west of the CCF, two miles upstream of the Banks Pumping Plant. The Skinner Fish Facility screens fish away from the pumps that lift water into the CA. Large fish and debris are directed away from the facility by a 388-foot long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers, while the main flow of water continues through the louvers and towards the pumps. These fish pass through a secondary system of screens and pipes into seven holding tanks, where a subsample is counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks.

The Banks Pumping Plant is in the South Delta, about eight miles northwest of Tracy and marks the beginning of the CA. By means of 11 pumps, including two rated at 375 cfs capacity, five at 1,130 cfs capacity, and four at 1,067 cfs capacity, the plant provides the initial lift of water 244 feet into the CA. The nominal capacity of the Banks Pumping Plant is 10,300 cfs.

Other SWP operated facilities in and near the Delta include the North Bay Aqueduct (NBA), the Suisun Marsh Salinity Control Gates (SMSCG), Roaring River Distribution System (RRDS), and up to four temporary barriers in the South Delta. These facilities are discussed further below.

3.2.2.1 Clifton Court Forebay

Inflows to CCF are controlled by radial gates, whose real-time operations are constrained by a scouring limit (i.e. 12,000 cfs) at the gates and by water level concerns in the South Delta for local agricultural diverters. An interim agreement between DWR and South Delta Water Agency specifies three modes, or "priorities" for CCF gate operation. Of the three priorities, Priority 1 is the most protective of South Delta water levels. Under Priority 1, CCF gates are only opened during the ebb tides, allowing the flood tides to replenish South Delta channels. Priority 2 is slightly less protective because the CCF gates may be open as in Priority 1, but also during the last hour of the higher flood tide and through most of the lower flood tide. Finally, Priority 3 requires that the CCF gates be closed during the rising limb of the higher flood tide and also during the lowest part of the lower tide, but permits the CCF gates to be open at all other times.

When a large head differential exists between the outside and the inside of the gates, theoretical inflow can be as high as 15,000 cfs for a very short time. However, existing operating procedures identify a maximum design flow rate of 12,000 cfs, to minimize water velocities in surrounding South Delta channels, to control erosion, and to prevent damage to the facility.

3.2.2.1.1 Maintenance of Clifton Court Forebay - Aquatic Weed Control Program

DWR will apply herbicides or will use mechanical harvesters on an as-needed basis to control aquatic weeds and algal blooms in CCF. Herbicides may include Komeen®, a chelated copper herbicide (copper-ethylenediamine complex and copper sulfate pentahydrate) and Nautique® is a copper carbonate compound (see Sepro product labels). These products are used to control algal blooms so that such algae blooms do not degrade drinking water quality through tastes and odors and production of algal toxins. Dense growth of submerged aquatic weeds, predominantly Egeria densa, can cause severe head loss and pump cavitation at Banks Pumping Plant when the stems of the rooted plant break free and drift into the trashracks. This mass of uprooted and broken vegetation essentially forms a watertight plug at the trashracks and vertical louver array. The resulting blockage necessitates a reduction in the pumping rate of water to prevent potential equipment damage through cavitation at the pumps. Cavitation creates excessive wear and deterioration of the pump impeller blades. Excessive floating weed mats also reduce the efficiency of fish salvage at the Skinner Fish Facility. Ultimately, this all results in a reduction in the volume of water diverted by the SWP.

Herbicide treatments will occur only in July and August on an as needed basis in the CCF dependent upon the level of vegetation biomass in the enclosure. Because the treatments will only be during July and August and longfin smelt are not expected to be present in the CCF during this time, adverse effects to longfin smelt are unlikely.

3.2.2.2 Skinner Fish Facility

The Skinner Fish Facility is located west of the CCF, two miles upstream of the Banks Pumping Plant. The Skinner Fish Facility screens fish away from the pumps that lift water into the CA. Large fish and debris are directed away from the facility by a 388-foot long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers, while the main flow of water continues through the louvers and towards the pumps. These fish pass through a secondary system of screens and pipes into seven holding tanks, where a subsample is counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks.

3.2.2.3 Banks Pumping Plant

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3.2.3 Suisun Marsh Facilities

Since the early 1970s, the California Legislature, SWRCB, Bureau of Reclamation (Reclamation), DFG, Suisun Resource Conservation District (SRCD), DWR, and other agencies have worked to preserve beneficial uses of Suisun Marsh in mitigation for perceived impacts of reduced Delta Outflow on the salinity regime. Early on, salinity standards were set by the SWRCB to protect alkali bulrush production, a primary waterfowl plant food. The most recent standard under SWRCB Decision 1641 (D-1641) acknowledges that multiple beneficial uses deserve protection.

A contractual agreement between DWR, Reclamation, DFG and SRCD contains provisions for DWR and Reclamation to mitigate the effects on Suisun Marsh channel water salinity from the SWP and Central Valley Project (CVP) operations and other upstream diversions. The Suisun Marsh Preservation Agreement, as amended, (SMPA) requires DWR and Reclamation to meet salinity standards (Stations are illustrated in Figure 3-1), sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements. In addition to the contractual agreement, SWRCB Decision 1485 (D-1485) requires DWR and Reclamation to meet specified salinity standards, which are consistent with the SMPA.

There are two primary physical mechanisms for meeting salinity standards set forth in D-1641 and the SMPA: (1) the implementation and operation of physical facilities in the Suisun Marsh; and (2) management of Delta outflow (i.e. facility operations are driven largely by salinity levels upstream of Montezuma Slough and salinity levels are highly sensitive to Delta outflow). Physical facilities (described below) have been operating since the early 1980s and have proven to be a highly reliable method for meeting standards. However, since Delta outflow cannot be actively managed by the SMPA, Suisun facility operations must be adaptive in response to changing salinity levels in the Delta.

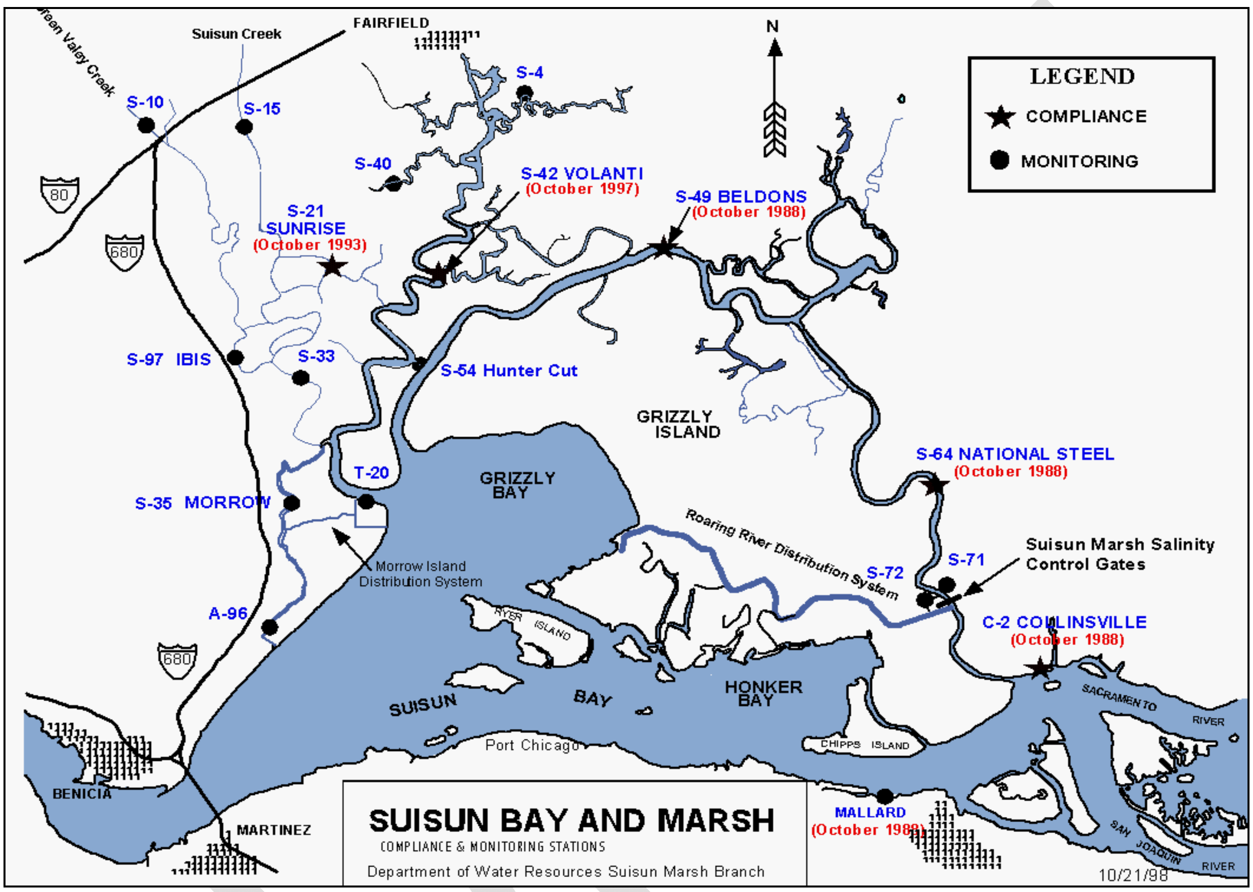


Figure 3-1. Compliance and Monitoring Stations and Salinity Control Facilities in Suisun Marsh

3.2.3.1 CALFED Charter for Development of an Implementation Plan for Suisun Marsh Wildlife Habitat Management and Preservation

The goal of the CALFED Charter is to develop a regional plan that balances implementation of the CALFED Program, SMPA, and other management and restoration programs within Suisun Marsh. This is to be conducted in a manner that is responsive to the concerns of stakeholders and based upon voluntary participation by private land owners. The Habitat Management, Preservation, and Restoration Plan for the Suisun Marsh (Suisun Marsh Plan) and its accompanying Programmatic Environmental Impact Statement/Report will develop, analyze, and evaluate potential effects of various actions in the Suisun Marsh. The actions are intended to preserve and enhance managed seasonal wetlands, implement a comprehensive levee protection/improvement program, and protect ecosystem and drinking water quality, while restoring habitat for tidal marsh dependent sensitive species, consistent with the CALFED Bay-Delta Program's strategic goals and objectives. USFWS and Reclamation are National Environmental Policy Act (NEPA) co-leads while DFG is the lead State CEQA agency.

3.2.3.2 Suisun Marsh Salinity Control Gates

The SMSCG are located on Montezuma Slough about two miles downstream from the confluence of the Sacramento and San Joaquin Rivers, near Collinsville. Operation of the SMSCG began in October 1988 as Phase II of the Plan of Protection for the Suisun Marsh. The objective of SMSCG operation is to decrease the salinity of the water in Montezuma Slough. The facility, spanning the 465-foot width of Montezuma Slough, consists of a boat lock, a series of three radial gates, and removable flashboards. The gates control salinity by restricting the flow of higher salinity water from Grizzly Bay into Montezuma Slough during incoming tides and retaining lower salinity Sacramento River water from the previous ebb tide. Operation of the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of water from east to west.

When Delta outflow is low to moderate and the gates are not operating, tidal flow past the gate is approximately +/- 5,000-6,000 cfs while the net flow is near zero. When operated, flood tide flows are arrested while ebb tide flows remain in the range of 5,000-6,000 cfs. The net flow in Montezuma Slough becomes approximately 2,500-2,800 cfs. The Corps of Engineers permit for operating the SMSCG requires that it be operated between October and May only when needed to meet Suisun Marsh salinity standards. Historically, the gate has been operated as early as October 1, while in some years (e.g. 1996) the gate was not operated at all. When the channel water salinity decreases sufficiently below the salinity standards, or at the end of the control season, the flashboards are removed and the gates raised to allow unrestricted movement through Montezuma Slough. Details of annual gate operations can be found in “Summary of Salinity Conditions in Suisun Marsh During WYs 1984-1992", or the “Suisun Marsh Monitoring Program Data Summary” produced annually by DWR, Division of Environmental Services.

The approximately 2,800 cfs net flow induced by SMSCG operation is effective at moving the salinity downstream in Montezuma Slough. Salinity is reduced by roughly one-hundred percent at Beldons Landing, and lesser amounts further west along Montezuma Slough. At the same time, the salinity field in Suisun Bay moves upstream as net Delta outflow (measured nominally at Chipps Island) is reduced by gate operation (Figure 3-2). Net outflow through Carquinez Strait is not affected. Figure 2-2 indicates the approximate position of X2 (the distance in kilometers up the axis of the Estuary to where the tidally averaged near-bottom salinity is 2 practical salinity units) and how it is transported upstream when the gate is operated.

It is important to note that historical gate operations (1988 – 2002) were much more frequent than recent and current operations (2006 – May 2008) (Figure 3-3). Operational frequency is affected by many drivers (hydrologic conditions, weather, Delta outflow, tide, fishery considerations, etc). The gates have also been operated for scientific studies. The gates were operated between 60 and 120 days between October and December during the early years (1988-2004). Salmon passage studies between 1998 and 2003 increased the number of operating days by up to 14 to meet study requirements. After discussions with National Marine Fisheries Service (NMFS) based on study findings, the boat lock portion of the gate is now held open at all times during SMSCG operation to allow for continuous salmon passage opportunity. With increased understanding of the effectiveness of the gates in lowering salinity in Montezuma Slough, salinity standards have been met with less frequent gate operation since 2006. Despite very low outflow in the fall of the two most recent water years, gate operation was not required at all in fall 2007 and was limited to 17 days in winter 2008. Assuming no significant, long-term changes in the drivers mentioned above, this level of operational frequency (10 to 20 days per year) can generally be expected to continue to meet standards in the future except perhaps during the most critical hydrologic conditions and/or other conditions that affect Delta outflow.

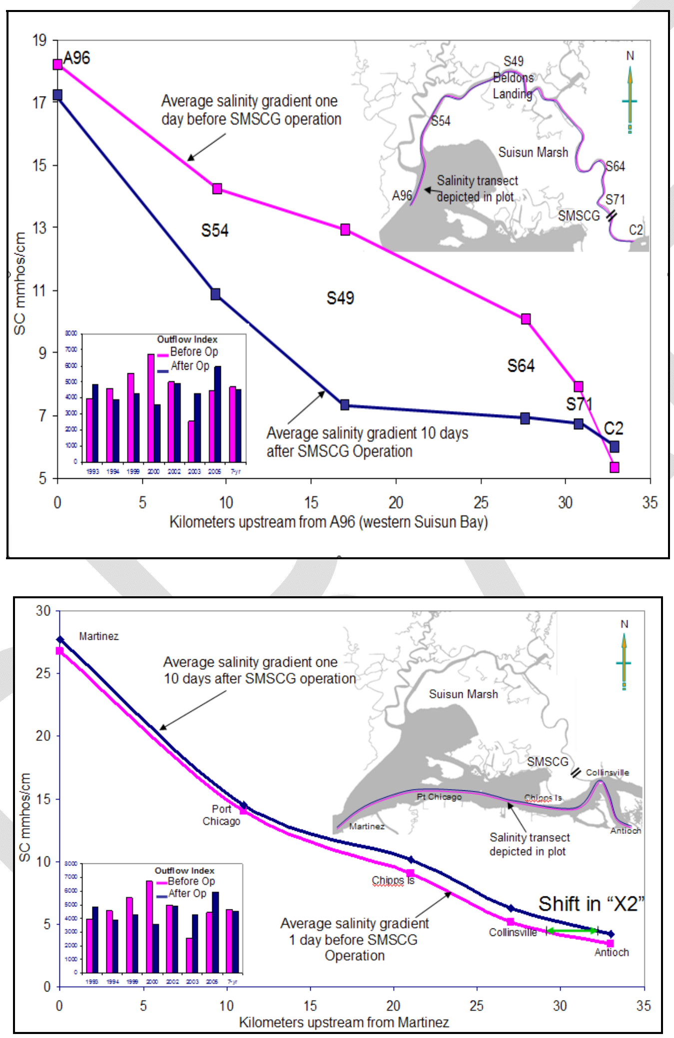


Figure 3-2. Average of Seven Years Salinity Response to SMSCG Gate Operation in Montezuma Slough and Suisun Bay

Note: Magenta line is salinity profile 1 day before gate operation; blue line is salinity 10 days after gate operation.

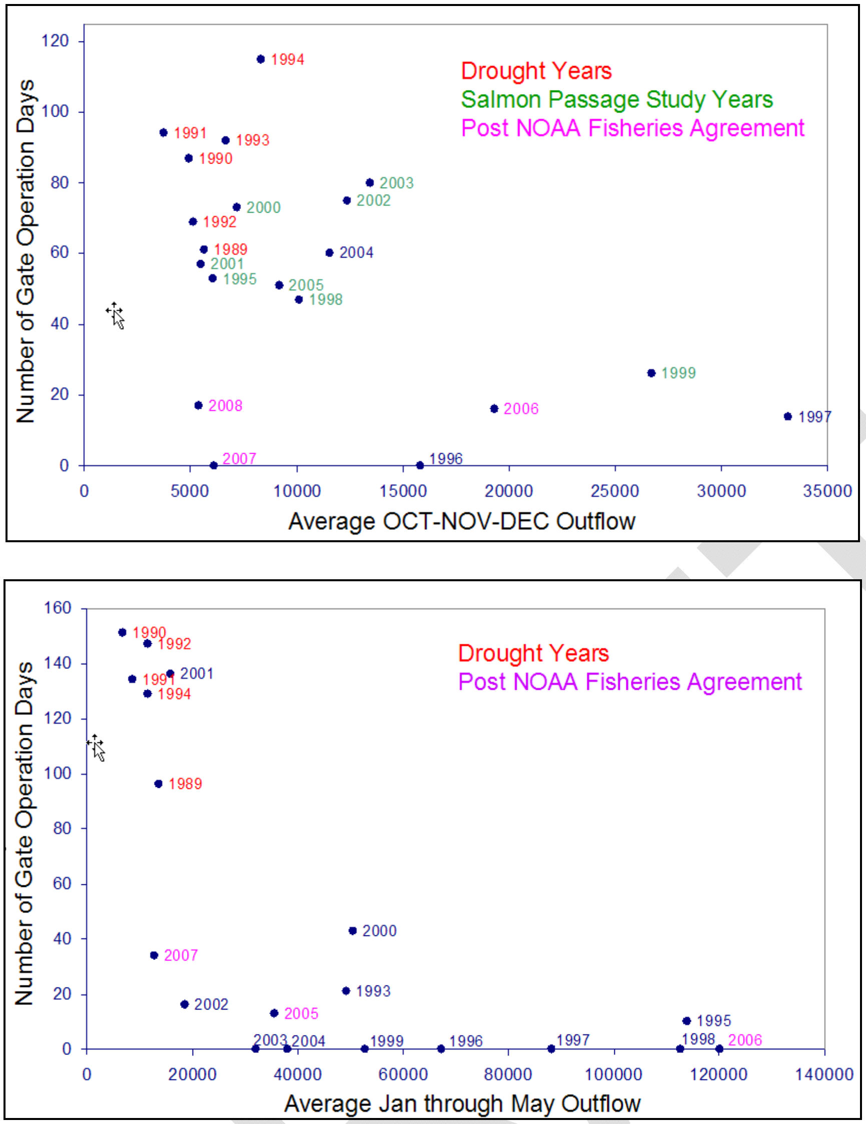


Figure 3-3. SMSCG Operation Frequency Versus Outflow Since 1988

3.2.3.3 SMSCG Fish Passage Study

The SMSCG were constructed and operate under Permit 16223E58 issued by the Corps, which includes a special condition to evaluate the nature of delays to migrating fish. Ultrasonic telemetry studies in 1993 and 1994 showed that the physical configuration and operation of the gates during the Control Season have a negative effect on adult salmonid passage (Tillman et al. 1996; Edwards et al. 1996).

DWR coordinated additional fish passage studies in 1998, 1999, 2001, 2002, 2003, and 2004. Migrating adult fall-run Chinook salmon were tagged and tracked by telemetry in the vicinity of the SMSCG to assess potential measures to increase the salmon passage rate and decrease salmon passage time through the gates.

Results in 2001, 2003, and 2004 indicate that leaving the boat-lock open during the Control Season when the flashboards are in place at the SMSCG and the radial gates are tidally operated provides a nearly equivalent fish passage to the Non-Control Season configuration when the flashboards are out and the radial gates are open. This approach minimizes delay and blockage of adult Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead migrating upstream during the Control Season while the SMSCG is operating. However, the boatlock gates may be closed temporarily to stabilize flows to facilitate safe passage of watercraft through the facility.

Reclamation and DWR are continuing to coordinate with the SMSCG Steering Committee in identifying water quality criteria, operational rules, and potential measures to facilitate removal of the flashboards during the Control Season that would provide the most benefit to migrating fish. However, the flashboards would not be removed during the Control Season unless it was certain that standards would be met for the remainder of the Control Season without the flashboards installed.

3.2.3.4 Roaring River Distribution System

The RRDS was constructed during 1979 and 1980 as part of the Initial Facilities in the Plan of Protection for the Suisun Marsh. The system was constructed to provide lower salinity water to 5,000 acres of private and 3,000 acres of DFG-managed wetlands on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly islands.

The RRDS includes a 40-acre intake pond that supplies water to Roaring River Slough. Motorized slide gates in Montezuma Slough and flap gates in the pond control flows through the culverts into the pond. A manually operated flap gate and flashboard riser are located at the confluence of Roaring River and Montezuma Slough to allow drainage back into Montezuma Slough for controlling water levels in the distribution system and for flood protection. DWR owns and operates this drain gate to ensure the Roaring River levees are not compromised during extremely high tides.

Water is diverted through a bank of eight 60-inch-diameter culverts equipped with fish screens into the Roaring River intake pond on high tides to raise the water surface elevation in RRDS above the adjacent managed wetlands. Managed wetlands north and south of the RRDS receive water, as needed, through publicly and privately owned turnouts on the system.

The intake to the RRDS is screened to prevent entrainment of fish larger than approximately 25 mm. DWR designed and installed the screens based on DFG criteria. The screen is a stationary vertical screen constructed of continuous-slot stainless steel wedge wire. All screens have 3/32-inch slot openings. After the listing of delta smelt, RRDS diversion rates have been controlled to maintain an average approach velocity below 0.2 ft/s at the intake fish screen. Initially, the intake culverts were held at about 20 percent capacity to meet the velocity criterion at high tide. Since 1996, the motorized slide gates have been operated remotely to allow hourly adjustment of gate openings to maximize diversion throughout the tide.

Routine maintenance of the system is conducted by DWR and primarily consists of maintaining the levee roads and fish screens. RRDS, like other levees in the marsh, have experienced subsidence since the levees were constructed in 1980. In 1999, DWR restored all 16 miles of levees to design elevation as part of damage repairs following the 1998 flooding in Suisun Marsh. In 2006, portions of the north levee were repaired to address damage following the January 2006 flooding.

3.2.3.5 Morrow Island Distribution System

The Morrow Island Distribution System (MIDS) was constructed in 1979 and 1980 in the south-western Suisun Marsh as part of the Initial Facilities in the Plan of Protection for the Suisun Marsh. The contractual requirement for Reclamation and DWR is to provide water to the ownerships so that lands may be managed according to approved local management plans. The system was constructed primarily to channel drainage water from the adjacent managed wetlands for discharge into Suisun Slough and Grizzly Bay. This approach increases circulation and reduces salinity in Goodyear Slough (GYS).

The MIDS is used year-round, but most intensively from September through June. When managed wetlands are filling and circulating, water is tidally diverted from Goodyear Slough just south of Pierce Harbor through three 48-inch culverts. Drainage water from Morrow Island is discharged into Grizzly Bay by way of the C-Line Outfall (two 36-inch culverts) and into the mouth of Suisun Slough by way of the M-Line Outfall (three 48- inch culverts), rather than back into Goodyear Slough. This helps prevent increases in salinity due to drainage water discharges into Goodyear Slough. The M-Line ditch is approximately 1.6 miles in length and the C-Line ditch is approximately 0.8 miles in length.

The 1997 USFWS BO issued for dredging of the facility included a requirement for screening the diversion to protect delta smelt. Due to the high cost of fish screens and the lack of certainty surrounding their effectiveness at MIDS, DWR and Reclamation proposed to investigate fish entrainment at the MIDS intake with regard to fishery populations in Goodyear Slough and to evaluate whether screening the diversion would provide substantial benefits to local populations of listed fish species.

To meet contractual commitments, the typical MIDS annual operations are described in detail in the 2008 OCAP Biological Assessment. There are currently no plans to modify operations.

3.2.3.6 Goodyear Slough Outfall

The Goodyear Slough Outfall was constructed in 1979 and 1980 as part of the Initial Facilities. A channel approximately 69 feet wide was dredged from the south end of Goodyear Slough to Suisun Bay (about 2,800 feet). The excavated material was used for levee construction. The control structure consists of four 48-inch culverts with flap gates on the bay side. On ebb tides, Goodyear Slough receives watershed runoff from Green Valley Creek and, to a lesser extent, Suisun Creek. The system was designed to draw creek flow south into Goodyear Slough, and thereby reduce salinity, by draining water one-way from the lower end of Goodyear Slough into

Suisun Bay on the ebb tide. The one-way flap gates at the Outfall close on flood tide keeping saltier bay water from mixing into the slough. The system creates a small net flow in the southerly direction overlaid on a larger, bi-directional tidal flow. The system provides lower salinity water to the wetland managers who flood their ponds with Goodyear Slough water. Another initial facility, the Morrow Island Distribution System, diverts from Goodyear slough and receives lower salinity water. Since the gates are passively operated (in response to water surface elevation differentials) there are no operations schedules or records. The system is open for free fish movement except very near the Outfall when flap gates are closed during flood tides.

3.2.4 South Delta Temporary Barriers Project

The South Delta Temporary Barrier Project (TBP) was initiated by DWR in 1991. Permit extensions were granted in 1996 and again in 2001 to extend the TBP through 2007. DWR recently extended its Corps permit to 2010. The USFWS assessed the operational effects of the TBP in the recent 2008 USFWS Biological Opinion. The NMFS submitted a biological opinion to the Corps in May 2008 which provides incidental take coverage for the continuation of the TBP through 2010.

The project consists of four rock barriers across South Delta channels. In various combinations, these barriers improve water levels and San Joaquin River salmon migration in the South Delta. The existing TBP consists of installation and removal of temporary rock barriers at the following locations:

Middle River near Victoria Canal, about 0.5 miles south of the confluence of Middle River, Trapper Slough, and North Canal
Old River near Tracy, about 0.5 miles east of the Delta-Mendota Canal intake
Grant Line Canal near Tracy Boulevard Bridge, about 400 feet east of Tracy Boulevard Bridge
The head of Old River at the confluence of Old River and San Joaquin River

The barriers on Middle River, Old River near Tracy, and Grant Line Canal are flow control facilities designed to improve water levels for agricultural diversions and are in place during the growing season. Under the USFWS biological opinion for the Temporary Barriers, operation of the barriers at Middle River and Old River near Tracy can begin May 15, or as early as April 15 if the spring barrier at the head of Old River is in place. From May 16 to May 31 (if the barrier at the head of Old River is removed) the tide gates are tied open in the barriers in Middle River and Old River near Tracy. After May 31, the barriers in Middle River, Old River near Tracy, and Grant Line Canal are permitted to be operational until they are completely removed by November 30.

During the spring, the barrier at the head of Old River is designed to reduce the number of out-migrating salmon smolts entering Old River. During the fall, this barrier is designed to improve flow and dissolved oxygen conditions in the San Joaquin River for the immigration of adult fall-run Chinook salmon. The barrier at the head of Old River barrier is typically in place between April 15 to May 15 for the spring, and between early September to late November for the fall.

Installation and operation of the barrier also depends on San Joaquin flow conditions. As required under the 2008 USFWS Delta smelt Biological Opinion, DWR will only install the head of Old River barrier in the Spring if USFWS determines that delta smelt entrainment is not a concern (USFWS 2008).

3.2.4.1 Proposed Installation and Operations of the Temporary Barriers

The installation and operation of the TBP will continue until the permanent gates are constructed. The proposed installation schedule through 2010 will be identical to the current schedule. In 2008, court rulings to protect delta smelt, prohibited the installation of the spring HOR barrier. As a result, the agricultural barriers installations were delayed according to the current permits until mid-May. As noted above, in the spring, the head of Old River barrier will only be installed if USFWS determines that delta smelt entrainment is not a concern.

To improve water circulation and quality, DWR in coordination with the South Delta Water Agency and Reclamation, began in 2007 to manually tie open the culvert flap gates at the Old River near Tracy barrier to improve water circulation and untie them when water levels fell unacceptably. This operation is expected to continue in subsequent years as needed to improve quality. Adjusting the barrier weir heights is being considered to improve water quality and circulation. DWR will consult with USFWS and NMFS if changes in the height of any or all of the weirs are sought.

If the permanent gates are constructed, temporary barrier operations will continue as planned and permitted. Computer model forecasts, real time monitoring, and coordination with local, State, and Federal agencies and stakeholders will help determine if the temporary rock barriers operations need to be modified during the transition period.

3.2.4.2 Temporary Barriers Conservation Strategies and Mitigation Measures

DWR has complied with various measures and conditions required by regulatory agencies under past and current permits to avoid, minimize, and compensate for the TBP impacts have been complied with by DWR. An ongoing monitoring plan is implemented each year the barriers are installed and an annual monitoring report is prepared to summarize the activities. The monitoring elements include fisheries monitoring and water quality analysis, Head of Old River fish entrainment and Kodiak trawling study, salmon smolt survival investigations, barrier effects on SWP and CVP entrainment, Swainson’s Hawk monitoring, water elevation, water quality sampling, and hydrologic modeling. DWR operates fish screens at Sherman Island.

3.3 Project Management Objectives

The SWP is managed to maximize the capture of water in the Delta and the usable supply released to the Delta from Oroville Reservoir storage. The maximum daily pumping rate at Banks is controlled by a combination of the D-1641, the real-time decision making to assist in fishery management process described previously, and permits issued by the Corps that regulate the rate of diversion of water into CCF for pumping at Banks. This diversion rate is normally restricted to 6,680 cfs as a three-day average inflow to CCF and 6,993 cfs as a one-day average inflow to CCF. CCF diversions may be greater than these rates between December 15 and March 15, when the inflow into CCF may be augmented by one-third of the San Joaquin River flow at Vernalis when those flows are equal to or greater than 1,000 cfs. Additionally, the SWP has a permit to export an additional 500 cfs between July 1 and September 30 (further details on this pumping are found later in the Project Description). The purpose for the current permitted action is to replace pumping foregone for the benefit of Delta fish species, making the summer limit effectively 7,180 cfs.

The hourly operation of the CCF radial gates is governed by agreements with local agricultural interests to protect water levels in the South Delta area. The radial gates controlling inflow to the forebay may be open during any period of the tidal cycle with the exception of the two hours before and after the low-low tide and the hours leading up to the high-high tide each day. CCF gate operations are governed by agreements and response plans to protect South Delta water users, and a more detailed discussion of these operations and agreement will follow under CCF and Joint Point of Diversion sections.

Banks is operated to minimize the impact to power loads on the California electrical grid to the extent practical, using CCF as a holding reservoir to allow that flexibility. Generally more pump units are operated during off-peak periods and fewer during peak periods. Because the installed capacity of the pumping plant is 10,300 cfs, the plant can be operated to reduce power grid impacts, by running all available pumps at night and a reduced number during the higher energy demand hours, even when CCF is admitting the maximum permitted inflow.

There are years (primarily wetter years) when Banks operations are demand limited, and Banks is able to pump enough water from the Delta to fill San Luis Reservoir and meet all contractor demands without maximizing its pumping capability every day of the year. This has been less likely in recent years, where the contractors request all or nearly their entire contract Table A amount every year. Consequently, current Banks operations are more often supply limited. Under these current full demand conditions, Banks Pumping Plant is almost always operated to the maximum extent possible to maximize the water captured, subject to the limitations of water quality, Delta standards, and a host of other variables, until all needs are satisfied and all storage south of the Delta is full.

San Luis Reservoir is an offstream storage facility located along the CA downstream of Banks. San Luis Reservoir is used by both projects to augment deliveries to their contractors during periods when Delta pumping is insufficient to meet downstream demands. San Luis Reservoir operates like a giant regulator on the SWP system, accepting any water pumped from Banks that exceeds contractor demands, then releasing that water back to the aqueduct system when Banks pumping is insufficient to meet demands. The reservoir allows the SWP to meet peak-season demands that are seldom balanced by Banks pumping.

San Luis Reservoir is generally filled in the spring or even earlier in some years. When it and other SWP storage facilities south of the Delta are full or nearly so, when Banks pumping is meeting all current Table A demands, and when the Delta is in excess conditions, DWR will use any available excess pumping capacity at Banks to deliver Article 21 water to the SWP contractors.

Article 21 water is one of several types of SWP water supply made available to the SWP contractors under the long-term SWP water supply contracts between DWR and the SWP contractors. As its name implies, Article 21 water is provided for under Article 21 of the contracts. Unlike Table A water, which is an allocated annual supply made available for scheduled delivery throughout the year, Article 21 water is an interruptible water supply made available only when certain conditions exist. As with all SWP water, Article 21 water is supplied under existing SWP water rights permits, and is pumped from the Delta under the same environmental, regulatory, and operational constraints that apply to all SWP supplies.

When Article 21 water is available, DWR may only offer it for a short time, and the offer may be discontinued when the necessary conditions no longer exist. Article 21 deliveries are in addition to scheduled Table A deliveries; this supply is delivered to contractors that can, on relatively short notice, put it to beneficial use. Typically, contractors have used Article 21 water to meet needs such as additional short-term irrigation demands, replenishment of local groundwater basins, and storage in local surface reservoirs, all of which provide contractors with opportunities for better water management through more efficient coordination with their local water supplies. When Article 21 of the long-term water supply contracts was developed, both DWR and the contractors recognized that DWR was not capable of meeting the full contract demands in all years because not all of the planned SWP facilities had been constructed.

Article 21 water is typically offered to contractors on a short-term (daily or weekly) basis when all of the following conditions exist: the SWP share of San Luis Reservoir is physically full, or projected to be physically full within approximately one week at permitted pumping rates; other SWP reservoirs south of the Delta are at their storage targets or the conveyance capacity to fill these reservoirs is maximized; the Delta is in excess condition; current Table A demand is being fully met; and Banks has export capacity beyond that which is needed to meet current Table A and other SWP operational demands. The increment of available unused Banks capacity is offered as the Article 21 delivery capacity. Contractors then indicate their desired rate of delivery of Article 21 water. It is allocated in proportion to their Table A contractual quantities if requests exceed the amount offered. Deliveries can be discontinued at any time, when any of the above factors change. In the modeling for Article 21, deliveries are only made in months when the State share of San Luis Reservoir is full. In actual operations, Article 21 may be offered a few days in advance of actual filling. Article 21 water will not be offered until State storage in San Luis Reservoir is either physically full or projected to be physically full within approximately one week at permitted pumping rates. Also, any carried-over Environmental Water Account (EWA) water asset stored in the State share of San Luis Reservoir (whether it be from the use of the 500 cfs or other operational assets) will not be considered part of the SWP storage when determining the availability of Article 21. This will ensure that the carried-over EWA water asset does not result in increased Article 21 deliveries.

During parts of April and May, the Vernalis Adaptive Management Program (VAMP) takes effect as described in the CVP section above. The State and Federal pumps reduce their export pumping to benefit fish in the San Joaquin River system. Around this same time, water demands from both agricultural and M&I contractors are increasing, Article 21 water is usually discontinued, and San Luis supplies are released to the SWP facilities to supplement Delta pumping at Banks, thereby meeting contractor demands. The SWP intends to continue VAMP-type export reductions through 2030 to the extent that the limited EWA assets, (as described in an earlier section) will meet the associated water costs. Chapter 9 of the 2008 OCAP biological assessment (BA) includes an analysis of modeling results that illustrates the frequency on which assets are available under a limited EWA to meet the SWP portion of VAMP.

Immediately following VAMP, a “post –VAMP shoulder” may occur. This action is an extension of the reduced pumping levels that occur during VAMP depending on the availability of EWA and limited EWA assets. Chapter 9 of the 2008 OCAP BA includes an analysis of modeling results that illustrates the frequency on which assets are available under a limited EWA to meet the “post – VAMP shoulder”.

After VAMP and the “post-VAMP shoulder”, Delta pumping at Banks can be increased depending on Delta inflow and Delta standards. By late May, demands usually exceed the restored pumping rate at Banks, and continued releases from San Luis Reservoir are needed to meet contractor demands for Table A water.

During this summer period, DWR is also releasing water from Oroville Reservoir to supplement Delta inflow and allow Banks to export the stored Oroville Reservoir water to help meet demand. These releases are scheduled to maximize export capability and gain maximum benefit from the stored water while meeting fish flow requirements, temperature requirements, Delta water quality, and all other applicable standards in the Feather River and the Delta.

DWR must balance storage between Oroville and San Luis reservoirs carefully to meet flood control requirements, Delta water quality and flow requirements, and optimize the supplies to its contractors consistent with all environmental constraints. Oroville Reservoir may be operated to move water through the Delta to San Luis Reservoir via Banks under different schedules depending on Delta conditions, reservoir storage volumes, and storage targets. Predicting those operational differences is difficult, as the decisions reflect operator judgment based on many real-time factors as to when to move water from Oroville Reservoir to San Luis Reservoir.

As San Luis Reservoir is drawn down to meet contractor demands, it usually reaches its low point in late August or early September. From September through early October, demand for deliveries usually drops below the ability of Banks to divert from the Delta, and the difference in Banks pumping is then added to San Luis Reservoir, reversing its spring and summer decline. From early October until the first major storms in late fall or winter unregulated flow continues to decline and releases from Lake Oroville are restricted (due to flow stability agreements with DFG) resulting in export rates at Banks that are somewhat less than demand typically causing a second seasonal decrease in the SWP’s share of San Luis Reservoir. Once the fall and winter storms increase runoff into the Delta, Banks can increase its pumping rate and eventually fill (in all but the driest years) the State portion of San Luis Reservoir before April of the following year.

3.3.1 Water Service Contracts, Allocations, and Deliveries

The following discussion presents the practices of DWR in determining the overall amount of Table A water that can be allocated and the allocation process itself. There are many variables that control how much water the SWP can capture and provide to its contractors for beneficial use.

The allocations were developed from analysis of a broad range of variables that include:

- Volume of water stored in Oroville Reservoir
- Flood operation restrictions at Oroville Reservoir
- End-of-water-year (September 30) target for water stored in Oroville Reservoir
- Volume of water stored in San Luis Reservoir
- End-of-month targets for water stored in San Luis Reservoir
- Snow survey results
- Forecasted runoff
- Feather River flow requirements for fish habitat
- Feather River service area delivery obligations
- Feather River flow for senior water rights river diversions
- Anticipated depletions in the Sacramento River basin
- Anticipated Delta conditions
- Precipitation and streamflow conditions since the last snow surveys and forecasts
- Contractor delivery requests and delivery patterns

From these and other variables, the Operations Control Office within DWR estimates the water supply available to allocate to contractors and meet other project needs. The Operations Control Office transmits these estimates to the SWP Analysis Office, where staff enters the water supply, contractor requests, and Table A amounts into a spreadsheet and computes the allocation percentage that would be provided by the available water supply.

The staffs of the Operations Control Office and SWP Analysis Office meet with DWR senior management, usually including the Director, to make the final decision on allocating water to the contractors. The decision is made, and announced in a press release followed by Notices to Contractors.

The initial allocation announcement is made by December 1 of each year. The allocation of water is made with a conservative assumption of future precipitation, and generally in graduated steps, carefully avoiding over-allocating water before the hydrologic conditions are well defined for the year.

Both the DWR and the contractors are conservative in their estimates, leading to the potential for significant variations between projections and actual operations, especially under wet hydrologic conditions.

Other influences affect the accuracy of estimates of annual demand for Table A and the resulting allocation percentage. One factor is the contractual ability of SWP contractors to carry over allocated but undelivered Table A from one year to the next if space is available in San Luis Reservoir. Contractors will generally use their carryover supplies early in the calendar year if it appears that San Luis reservoir will fill. By using the prior year’s carryover, the contractors reduce their delivery requests for the current year’s Table A allocation and instead schedule delivery of carryover supplies.

Carryover supplies left in San Luis Reservoir by SWP contractors may result in higher storage levels in San Luis Reservoir at December 31 than would have occurred in the absence of carryover. If there were no carryover privilege, contractors would seek to store the water within their service areas or in other storage facilities outside of their service areas. As project pumping fills San Luis Reservoir, the contractors are notified to take or lose their carryover supplies. If they can take delivery of and use or store the carryover water, San Luis Reservoir storage then returns to the level that would have prevailed absent the carryover program.

If the contractors are unable to take delivery of all of their carryover water, that water then converts to project water as San Luis Reservoir fills, and Article 21 water becomes available for delivery to contractors.

Article 21 water delivered early in the calendar year may be reclassified as Table A later in the year depending on final allocations, hydrology, and contractor requests. Such reclassification does not affect the amount of water carried over in San Luis Reservoir, nor does it alter pumping volumes or schedules. The total water exported from the Delta and delivered by the SWP in any year is a function of a number of variables that is greater than the list of variables shown above that help determine Table A allocations.

If there are no carryover or Article 21 supplies available, Table A requests will be greater in the January-April period, and there would be a higher percentage allocation of Table A for the year than if carryover and Article 21 were available to meet demand.

3.3.2 Monterey Agreement

In 1994, DWR and certain representatives of the SWP contractors agreed to a set of principles known as the Monterey Agreement, to settle long-term water allocation disputes, and to establish a new water management strategy for the SWP. This project description only includes the system-wide water operations consistent with the Monterey Agreement and not the specific actions by DWR and State Water Contractors needed to implement the agreement.

The Monterey Agreement resulted in 27 of the 29 SWP contractors signing amendments to their long-term water supply contracts in 1995, and the Monterey Amendment has been implemented as part of SWP operations for these 27 SWP contractors since 1996. The original Environmental Impact Report prepared for the Monterey Agreement was challenged, and the EIR was required to be decertified. DWR is currently preparing an EIR on the Monterey Amendment following that litigation and approval of a settlement agreement with the plaintiffs in May 2003. A draft of the new EIR was released in October 2007, the comment period closed in January 2008, and a final EIR is scheduled for completion in March 2009.

The alternatives evaluated in the EIR include continuation of the Monterey Amendment, certain No Project alternatives that would revert some contract terms to pre-Monterey Amendment terms, and two “court ordered no-project” alternatives that would impose a reduction in Table A supplies by implementing a permanent shortage provision together with an offsetting increase in the supply of Article 21 water.

Adoption of any of the alternatives would not measurably change SWP Delta operations, although the internal classification of water provided to SWP contractors could change as to the balance between Table A and Article 21 water, as could the relative allocation of water between urban and agricultural contractors. The Monterey Amendment provides for certain transfers of water from agricultural to urban contractors; impacts from those transfers are all south of the Delta and have no effect on the Delta.

The only impact of Monterey Amendment operations on Delta exports is identified in the draft EIR as the facilitation of approval for out-of-service-area storage programs. Because DWR had previously approved water storage programs outside of individual SWP contractor’s service areas and many such storage programs now exist, this water management method is unlikely to be voided by future actions of DWR. These increased exports can only occur if they are within the diversions permitted at the time. None of the alternatives being considered would result in demand for added Delta diversions above currently assumed levels and all are subject to whatever regulatory restrictions are in force at the time.

3.3.3 Changes in DWR’s Allocation of Table A Water and Article 21 Water

The Monterey Amendment revised the temporary shortage provision that specified an initial reduction of supplies for agricultural use when requests for SWP water exceeded the available supply. The Amendment specifies that whenever the supply of Table A water is less than the total of all contractors' requests, the available supply of Table A water is allocated among all contractors in proportion to each contractor's annual Table A amount.

The Monterey Amendment amended Article 21 by eliminating the category of scheduled "surplus water," which was available for scheduled delivery and by renaming "unscheduled water" to "interruptible water." Surplus water was scheduled water made available to the contractors when DWR had supplies beyond what was needed to meet Table A deliveries, reservoir storage targets, and Delta regulatory requirements. Surplus water and unscheduled water were made available first to contractors requesting it for agricultural use or for groundwater replenishment. Because of the contractors' increasing demands for Table A water and the increasing regulatory requirements imposed on SWP operations, DWR is now able to supply water that is not Table A water only on an unscheduled, i.e., interruptible basis.

Pursuant to the revised Article 21, DWR allocates the available interruptible supply to requesting contractors in proportion to their annual Table A amounts.

The result of these contractual changes are that DWR now allocates Table A and interruptible water among contractors in proportion to annual Table A amounts without consideration of whether the water would be used for M&I or agricultural purposes. Agricultural and M&I contractors share any reductions in deliveries or opportunities for surplus water in proportion to their annual Table A amounts.

3.3.4 Historical Water Deliveries to Southern California

The pumping from the Delta to serve southern California has been influenced by changes in available water supply sources to serve the region. The Colorado River and the SWP have been the major supply sources for southern California.

The Quantification Settlement Agreement (QSA) signed in 2003 resulted in a decrease in the amount of Colorado River water available to California. Since 1998, the Metropolitan Water District of Southern California (MWDSC) has filled Diamond Valley Lake (810,000 acre-feet, late 1998-early 2002) and adding some water to groundwater storage programs. In wetter years, demand for imported water may often decrease because local sources are augmented and local rainfall reduces irrigation demand.

3.3.5 Transfers

Transfers requiring export from the Delta are done at times when pumping and conveyance capacity at Banks or Jones is available to move the water. Additionally, operations to accomplish these transfers must be carried out in coordination with CVP and SWP operations, such that the capabilities of the Projects to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way.

In particular, parties to the transfer are responsible for providing for any incremental changes in flows required to protect Delta water quality standards. All transfers will be in accordance with all existing regulations and requirements.

Purchasers of water for water transfers may include Reclamation, DWR, SWP contractors, CVP contractors, other State and Federal agencies, or other parties. DWR and Reclamation have operated water acquisition programs in the past to provide water for environmental programs and additional supplies to SWP contractors, CVP contractors, and other parties. The DWR programs include the 1991, 1992, and 1994 Drought Water Banks and Dry Year Programs in 2001 and 2002. Reclamation operated a forbearance program in 2001 by purchasing CVP contractors' water in the Sacramento Valley for CVPIA in-stream flows, and to augment water supplies for CVP contractors south of the Delta and wildlife refuges. Reclamation administers the Central Valley Project Improvement Act (CVPIA) Water Acquisition Program for Refuge Level 4 supplies and fishery in-stream flows. The CALFED Ecosystem Restoration Program will, in the future, acquire water for fishery and ecosystem restoration. DWR, and potentially Reclamation in the future, has agreed to participate in a Yuba River Accord that will provide fish flows on the Yuba River and also water supply that may be transferred at DWR and Reclamation Delta facilities. It is anticipated that Reclamation will join in the Accord and fully participate in the Yuba Accord upon completion of the OCAP consultation. The Yuba River Accord water would be transferred to offset VAMP water costs.

Also in the past, CVP and SWP contractors have also independently acquired water and arranged for pumping and conveyance through SWP facilities. State Water Code provisions grant other parties access to unused conveyance capacity, although SWP contractors have priority access to capacity not being used by the DWR to meet SWP contract amounts.

The Yuba River Accord includes three separate but interrelated agreements that would protect and enhance fisheries resources in the lower Yuba River, increase local water supply reliability, and provide DWR with increased operational flexibility for protection of Delta fisheries resources through Project re-operation, and provision of added dry-year water supplies to State and Federal water contractors. These proposed agreements are the:

- Principles of Agreement for Proposed Lower Yuba River Fisheries Agreement (Fisheries Agreement)

- Principles of Agreement for Proposed Conjunctive Use Agreements (Conjunctive Use Agreements)

- Principles of Agreement for Proposed Long-term Transfer Agreement (Water Purchase Agreement)

The Fisheries Agreement was developed by State, Federal, and consulting fisheries biologists, fisheries advocates, and policy representatives. Compared to the interim flow requirements of the SWRCB Revised Water Right Decision 1644, the Fisheries Agreement would establish higher minimum instream flows during most months of most water years.

3.3.5.1 Transfer Capacity

DWR assumes as part of the project description that the water transfer programs for environmental and water supply augmentation will continue in some form, and that in most years (all but the driest), the scope of annual water transfers will be limited by available Delta pumping capacity, and exports for transfers will be limited to the months July through September. As such, looking at an indicator of available transfer capacity in those months is one way of estimating an upper boundary to the effects of transfers on an annual basis.

The CVP and SWP may provide Delta export pumping for transfers using pumping capacity at Banks and Jones beyond that which is being used to deliver project water supply, up to the physical maximums of the pumps, consistent with prevailing operations constraints such as Export to Inflow (E/I) ratio, conveyance or storage capacity, and any protective criteria in effect that may apply as conditions on such transfers. For example, pumping for transfers may have conditions for protection of Delta water levels, water quality, fisheries, or other beneficial uses.

The surplus capacity available for transfers will vary a great deal with hydrologic conditions. In general, as hydrologic conditions get wetter, surplus capacity diminishes because the CVP and SWP are more fully using export pumping capacity for Project supplies. CVP's Jones Pumping Plant, with no forebay for pumped diversions and with limited capability to fine tune rates of pumping, has little surplus capacity, except in the driest hydrologic conditions. The SWP has the most surplus capacity in critical and some dry years, less or sometimes none in a broad middle range of hydrologic conditions, and some surplus again in some above normal and wet years when demands may be lower because contractors have alternative supplies.

The availability of water for transfer and the demand for transfer water may also vary with hydrologic conditions. Accordingly, since many transfers are negotiated between willing buyers and sellers under prevailing market conditions, price of water also may be a factor determining how much is transferred in any year. This document does not attempt to identify how much of the available and useable surplus export capacity of the CVP and SWP will actually be used for transfers in a particular year, but recent history, the expectations for the future limited EWA, and the needs of other transfer programs suggest a growing reliance on transfers.

Under both the present and future conditions, capability to export transfers will often be capacity-limited, except in Critical and some Dry years. In these Critical and some Dry years, both Banks and Jones have more available capacity for transfers, so export capacity is less likely to limit transfers. Rather, either supply or demand for transfers may be a limiting factor. During such years, low project exports and high demand for water supply could make it possible to transfer larger amounts of water.

3.3.5.2 Proposed Exports for Transfers

Although transfers may occur at any time of year, proposed exports for transfers apply only to the months July through September. For transfers outside those months, or in excess of the proposed amounts, Reclamation and DWR would request separate consultation. In consideration of the estimates of available capacity for export of transfers during July through September, and in recognition of the many other possible operations contingencies and constraints that may limit actual use of that capacity for transfers, the proposed use of SWP/CVP export capacity for transfers in thousand acre-feet (TAF) is as follows:

Water Year Class	Maximum Transfer Amount
Critical	up to 600 TAF
Dry (following Critical)	up to 600 TAF
Dry (following Dry)	up to 600 TAF
All other Years	up to 360 TAF

3.4 Environmental Water Account

The EWA was established in 2000 by the CALFED record of decision (ROD), and operating criteria are described in detail in the EWA Operating Principles Agreement attachment to the ROD. In 2004, the EWA was extended to operate through the end of 2007. Reclamation, the Service, and NMFS have received Congressional authorization to participate in the EWA at least through September 30, 2010, per the CALFED Bay-Delta Authorization Act (PL-108-361). However, for these Federal agencies to continue participation in the EWA beyond 2010, additional authorization will be required.

The original purpose of the EWA was to enable diversion of water by the SWP and CVP from the Delta to be reduced at times when at risk fish species may be harmed while preventing the uncompensated loss of water to SWP and CVP contractors. Typically the EWA replaced water loss due to curtailment of pumping by purchase of surface or groundwater supplies from willing sellers and by taking advantage of regulatory flexibility and certain operational assets. Under past operations, from 2001 through 2007, when there were pumping curtailments at Banks Pumping Plant to protect Delta fish the EWA often owed a debt of water to the SWP, usually reflected in San Luis Reservoir.

The EWA agencies (the Project and fisheries agencies – DWR, Reclamation, and USFWS, NMFS, and DFG) are currently undertaking environmental review to determine the future of EWA. Because no decision has yet been made regarding EWA, for the purposes of this project description, EWA is analyzed with limited assets, focusing on providing assets to support VAMP and in some years, the “post – VAMP shoulder”. The EWA assets include the following:

- Implementation of the Yuba Accord Component 1 Water, which is an average 60,000 AF of water released annually from the Yuba River to the Delta, is an EWA asset through 2015, with a possible extension through 2025. The 60,000 AF is expected to be reduced by carriage water costs in most years, estimated at 20 percent, leaving an EWA asset of 48,000 AF per year. The SWP will provide the 48,000 AF per year asset from Project supplies beyond 2015 in the event that Yuba Accord Component 1 Water is not extended.

- Purchases of assets to the extent funds are available.

- Operational assets granted the EWA in the CALFED ROD:
    - A 50 percent share of SWP export pumping of (b)(2) water and Environmental Restoration Program (ERP) water from upstream releases;
    - A share of the use of SWP pumping capacity in excess of the SWP's needs to meet contractor requirements with the CVP on an equal basis, as needed (such use may be under Joint Point of Diversion);
    - Any water acquired through export/inflow ratio flexibility; and
    - Use of 500 cfs increase in authorized Banks Pumping Plant capacity in July through September (from 6,680 to 7,180 cfs).
    - Storage in Project reservoirs upstream of the Delta as well as in San Luis Reservoir, with a lower priority than Project water. Such stored water will share storage priority with water acquired for Level 4 refuge needs.

Operational assets averaged 82,000 AF from 2001-2006, with a range from 0 to 150,000 AF.

3.5 Delta Operations Regulatory Setting

3.5.1 State Water Resources Control Board Water Rights

3.5.1.1 1995 Water Quality Control Plan

The SWRCB adopted the 1995 Bay-Delta Water Quality Control Plan (WQCP) on May 22, 1995, which became the basis of SWRCB Decision-1641. The SWRCB continues to hold workshops and receive information regarding processes on specific areas of the 1995 WQCP. The SWRCB amended the WQCP in 2006, but to date, the SWRCB has made no significant changes to the 1995 WQCP framework. See discussion of revised WQCP (2006) below.

3.5.1.2 Decision 1641

The SWRCB imposes a myriad of constraints upon the operations of the CVP and SWP in the Delta. With D-1641, the SWRCB implements the objectives set forth in the SWRCB 1995 Bay-Delta WQCP and imposes flow and water quality objectives upon the Projects to assure protection of beneficial uses in the Delta. The SWRCB also grants conditional changes to points of diversion for the Projects with D-1641.

The various flow objectives and export restraints are designed to protect fisheries. These objectives include specific outflow requirements throughout the year, specific export restraints in the spring, and export limits based on a percentage of estuary inflow throughout the year. The water quality objectives are designed to protect agricultural, municipal and industrial, and fishery uses, and they vary throughout the year and by the wetness of the year. These objectives will remain in place until such time that the SWRCB revisits them per petition or as a consequence to revisions to the SWRCB Water Quality Plan for the Bay-Delta (which is to be revisited periodically).

On December 29, 1999, SWRCB adopted and then revised (on March 15, 2000) D-1641, amending certain terms and conditions of the water rights of the SWP and CVP. D-1641 substituted certain objectives adopted in the 1995 Bay-Delta Plan for water quality objectives that had to be met under the water rights of the SWP and CVP. In effect, D-1641 obligates the SWP and CVP to comply with the objectives in the 1995 Bay-Delta Plan. The requirements in D-1641 address the standards for fish and wildlife protection; M&I water quality, agricultural water quality, and Suisun Marsh salinity. SWRCB D-1641 also authorizes SWP and CVP to jointly use each other's points of diversion in the southern Delta, with conditional limitations and required response coordination plans. SWRCB D-1641 modified the Vernalis salinity standard under SWRCB Decision 1422 to the corresponding Vernalis salinity objective in the 1995 Bay-Delta Plan.

3.5.1.3 Revised WQCP (2006)

The SWRCB undertook a proceeding under its water quality authority to amend the WQCP for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay- Delta Plan) adopted in 1978 and amended in 1991 and in 1995. Prior to commencing this proceeding, the SWRCB conducted a series of workshops in 2004 and 2005 to receive information on specific topics addressed in the Bay-Delta Plan.

The SWRCB adopted a revised Bay-Delta Plan on December 13, 2006. There were no changes to the Beneficial Uses from the 1995 Plan to the 2006 Plan, nor were any new water quality objectives adopted in the 2006 Plan. A number of changes were made simply for readability. Consistency changes were also made to assure that sections of the 2006 Plan reflected the current physical condition or current regulation. The SWRCB continues to hold workshops and receive information regarding Pelagic Organism Decline (POD), Climate Change, and San Joaquin salinity and flows, and will coordinate updates of the Bay-Delta Plan with on-going development of the comprehensive Salinity Management Plan.

3.6 Minimization Measures for SWP Operations

Reasonable and Prudent Measures (RPMs) are included in the 2008 USFWS BO and DWR incorporates these measures into the SWP proposed project as minimization measures for the protection of longfin smelt.

1) To minimize adverse effects of operations of the NBA, annual evaluations shall be conducted for the fish screens at the NBA diversion during January through June. A proposed evaluation study shall be submitted to the DFG for approval within 3 months of the issuance of this biological opinion permit. The evaluation shall monitor fish entrained and impinged on the fish

screen, the screen approach velocities, cleanliness of the screen and any other pertinent criteria needed to determine the effectiveness of the fish screen.

3) To obtain real time data on the abundance and distribution of longfin smelt in the Bay-Delta, during the months of December through July, when water is being diverted DWR shall ensure that the frequency of sampling for longfin smelt at Banks will be at least 25 percent of the time.

DWR shall develop a methodology for quantitative longfin larval monitoring at Banks to help refine the triggers for the Actions in Components of the Reasonable and Prudent Alternative (RPA) described below under the Proposed SWP Operations to Protect Longfin Smelt. An interim plan shall be submitted to the DFG for approval within 30 days of the issuance of the permit so the monitoring can be implemented this year. A more detailed plan shall be developed and approved by the DFG within one year.

4) To minimize adverse effects of Banks on longfin smelt, DWR will develop within 30 days a methodology for dealing with transitions in operations after changes in OMR flow requirements.

Monitoring requirements will be implemented by DWR, in cooperation with Reclamation.

3.7 *Reporting Requirements*

DWR will immediately report to the DFG any information about take or suspected take of longfin smelt. DWR will notify the DFG within 24 hours of receiving such information. Notification must include the date, time, and location of the incident or of the finding of a dead or injured longfin smelt and will be processed according to DFG protocols.

3.8 Real Time Decision-Making to Assist Fishery Management

Real time decision-making to assist fishery management is a process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. For the proposed action high uncertainty exists for how to best manage water operations while protecting listed species. Sources of uncertainty relative to the proposed action include:

- Hydrologic conditions
- Ocean conditions
- Listed species biology

Under the proposed action the goals for real time decision-making to assist fishery management are:

- Meet contractual obligations for water delivery
- Minimize adverse effects for listed species

DWR works closely with USFWS, NMFS, and DFG to coordinate the operation of the SWP with fishery needs. This coordination is facilitated through several forums in a cooperative management process that allows for modifying operations based on real-time data that includes current fish surveys, flow and temperature information, and salvage or loss at the project facilities, (hereinafter “triggering event”).

3.9 *Water Operations Management Team*

The Water Operations Management Team (WOMT) is comprised of representatives from Reclamation, DWR, USFWS, NMFS, and DFG. This management-level team was established to facilitate timely decision-support and decision-making at the appropriate level. The WOMT first met in 1999, and will continue to meet to make management decisions as part of the proposed action. Routinely, it also uses the CALFED Ops Group to communicate with stakeholders about its decisions. Although the goal of WOMT is to achieve consensus on decisions, the participating agencies retain their authorized roles and responsibilities.

3.10 *Process for Real Time Decision- Making to Assist Fishery Management*

Decisions regarding SWP operations to avoid and minimize adverse effects on listed species must consider factors that include public health, safety, water supply reliability, and water quality. To facilitate such decisions, DWR, Reclamation, USFWS, NMFS, and DFG have developed and refined a set of processes for various fish species to collect data, disseminate information, develop recommendations, make decisions, and provide transparency. This process consists of three types of groups that meet on a recurring basis. Management teams are made up of management staff from Reclamation, DWR, USFWS, NMFS, and DFG. Information teams are teams whose role is to disseminate and coordinate information among agencies and stakeholders. Fisheries and Operations Technical Teams are made up of technical staff from State and Federal agencies. These teams review the most up-to-date data and information on fish status and Delta conditions, and develop recommendations that fishery agencies’ management can use in identifying actions to protect listed species.

The process to identify actions for protection of listed species varies to some degree among species but follows this general outline: A Fisheries or Operations Technical Team compiles and assesses current information regarding species, such as stages of reproductive development, geographic distribution, relative abundance, and physical habitat conditions; it then provides a recommendation to the agency with statutory obligation to enforce protection of the species in question. The agency’s staff and management will review the recommendation and use it as a basis for developing, in cooperation with Reclamation and DWR, a modification of water operations that will minimize adverse effects to listed species by the Projects. If DWR and Reclamation do not agree with the action, then the fishery agency with the statutory authority will make a final decision on an action that they deem necessary to protect the species.

The outcomes of protective actions that are implemented will be monitored and documented, and this information will inform future recommended actions.

3.11 *Groups Involved in Real Time Decision-Making to Assist Fishery*

3.11.1 Management and Information Sharing

The following teams assist with the collection of data and recommend changes to operations for the protection of longfin smelt.

3.11.1.1 CALFED Ops and Subgroups

The CALFED Ops Group consists of the Project agencies (DWR and Reclamation), the fishery agencies (USFWS, NMFS, and DFG), SWRCB staff, and the U.S. Environmental Protection Agency (EPA). The CALFED Ops Group generally has met eleven times a year in a public setting so that the agencies can inform each other and stakeholders about current the operations of the CVP and SWP, implementation of the CVPIA and State and Federal endangered species acts, and additional actions to contribute to the conservation and protection of State- and Federally-listed species. The CALFED Ops Group held its first public meeting in January 1995, and during the next six years the group developed and refined its process. The CALFED Ops Group has been recognized within SWRCB D-1641, and elsewhere, as one forum for coordination on decisions to exercise certain flexibility that has been incorporated into the Delta standards for protection of beneficial uses (e.g., E/I ratios, and some Delta Cross Channel [DCC] closures). Several groups or teams were established through the Ops Group process. Several fisheries specific teams have been established to provide guidance and recommendations on resource management issues. The group and team that relates to longfin smelt includes:

3.11.1.2 Data Assessment Team (DAT)

The DAT consists of technical staff members from the Project and fishery agencies as well as stakeholders. The DAT meets frequently during the fall, winter, and spring. The purpose of the meetings is to coordinate and disseminate information and data among agencies and stakeholders that is related to water project operations, hydrology, and fish surveys in the Delta.

3.11.1.3 Smelt Working Group (SWG)

The SWG evaluates biological and technical issues regarding delta smelt and develops recommendations for consideration by USFWS. Since the longfin smelt (Spirinchus thaleichthys) became a state candidate species in 2008, the SWG has also developed for DFG recommendations to minimize adverse effects to longfin smelt. The SWG consists of representatives from USFWS, DFG, DWR, EPA, and Reclamation. USFWS chairs the group, and members are assigned by each agency.

The SWG compiles and interprets the latest near real-time information regarding state- and federally-listed smelt, such as stages of development, distribution, and salvage. After evaluating available information and if they agree that a protection action is warranted, the SWG will submit their recommendations in writing to USFWS and DFG.

The SWG may meet at any time at the request of USFWS, but generally meets weekly during the months of December through June, when smelt salvage at Jones and Banks has occurred historically. However, the Delta Smelt Risk Assessment Matrix (see below) outlines the conditions when the SWG will convene to evaluate the necessity of protective actions and provide USFWS with a recommendation. Further, with the State listing of longfin smelt, the group will also convene based on longfin salvage history at the request of DFG.

3.12 State Water Project Operations for Protection of Longfin Smelt

DWR will implement the actions that are described as the three components (Components 1, 2 and 5) of the Reasonable and Prudent Alternative (RPA) in the December 15, 2008 USFWS BO on Delta Smelt and its Critical Habitat for the protection of longfin smelt. The components are to be implemented using an adaptive approach within specific constraints described below. The components presented are based on the best available scientific information regarding what is necessary to adequately provide for successful longfin smelt migration and spawning, and larval and juvenile survival, growth, rearing, and recruitment within the Bay-Delta. Supporting documentation is provided in Appendix 3 (Draft Longfin Smelt Effects Analysis) of this Initial Study and the USFWS Biological Opinion and Appendices (USFWS 2008).

The specific flow requirements, action triggers and monitoring stations prescribed in below will be continuously monitored and evaluated consistent with the adaptive process. As new information becomes available, these action triggers may be modified without necessarily requiring re-consultation on the overall proposed action.

The following actions are necessary to ensure that implementation of the long term operations of the SWP does not appreciably reduce the likelihood of both the survival and recovery of the longfin smelt through: (1) preventing/reducing entrainment of longfin smelt at Banks; (2) providing adequate habitat conditions that will allow the longfin smelt to successfully migrate and spawn in the Bay-Delta; (3) providing adequate habitat conditions that will allow larvae and juvenile longfin smelt to rear; and (4) providing suitable habitat conditions that will allow successful recruitment of juvenile longfin smelt to adulthood. In addition, it is essential to monitor longfin smelt abundance and distribution through continued sampling programs through the IEP. Through these actions, DWR will minimize the effects of the SWP operations on longfin smelt.

3.12.1 Process for Determining Specific Actions within Components 1 and 2

The following process for determining specific actions within Components 1 and 2 of the delta smelt Biological Opinion (USFWS 2008) will be used to protect longfin smelt. DWR has included in this process that DFG would have authority for final decision-making regarding the needs of longfin smelt. This modification is consistent with the purpose of the adaptive management process through which the fish agencies will consider the needs of other listed species to avoid unnecessary impacts to these species.

1. Within one day after the SWG recommends an action should be initiated, changed, suspended or terminated, the SWG shall provide to USFWS and DFG a written recommendation and a biological justification. The SWG shall use the process described in Attachments A and B of the 2008 USFWS OCAP BO to provide a framework for their recommendations. USFWS and DFG shall determine whether the proposed action should be implemented, changed, or terminated and the OMR needed to achieve the protection. USFWS and DFG shall present this information to the WOMT.

2. The WOMT shall concur with the recommendation or provide a written alternative to the recommendation to USFWS and DFG within one day. USFWS and DFG shall then make a final determination on the proposed action to be implemented, which shall be documented and posted on the Sacramento Fish and Wildlife Service's webpage.

3. Once USFWS and DFG make a final determination to initiate a new action, it shall be implemented within two days by the Projects, and shall remain in effect until it is terminated or replaced, as determined by USFWS, consistent with the description of the RPA and with Attachment B. Data demonstrating the implementation of the action shall be provided to USFWS and DFG weekly.

4. When an action is ongoing, but USFWS and DFG determine that an OMR flow change is required, the Projects shall adjust operations to the new OMR within two days of receipt of the determination. This new OMR flow shall be used until it is readjusted or the action is changed or terminated based on new information, as described in the RPA and Attachment B.

3.12.2 RPA Component 1: Protection of the Adult Delta/Longfin Smelt Life Stage

Delta and longfin smelt are entrained at the fish facilities each year. These actions are designed to reduce the delta/longfin smelt entrainment losses. The objective of Component 1 (Actions 1 and 2 in Attachment B of USFWS 2008) is to reduce entrainment of pre-spawning adult delta/longfin smelt during December to March by controlling OMR flows during vulnerable periods. Action 1 is designed to protect upmigrating delta/longfin smelt. Action 2 is designed to protect adult delta/longfin smelt that have migrated upstream and are residing in the Delta prior to spawning. Overall, RPA Component 1 will increase the suitability of spawning habitat for delta/longfin smelt by decreasing the amount of Delta habitat affected by the projects' export pumping plants' operations prior to, and during, the critical spawning period.

Beginning in December of each year, the DFG and USFWS shall review data on flow, turbidity, salvage, and other parameters that have historically predicted the timing of delta/longfin smelt migration into the Delta. On an ongoing basis, and consistent with the parameters outlined below and in Attachment B, the SWG shall recommend to the USFWS OMR flows that are expected to minimize entrainment of adult delta/longfin smelt. Throughout the implementation of RPA Component 1, the USFWS and DFG will make the final determination as to OMR flows required to protect delta/longfin smelt.

OMR flow requirements given below are based on the following understanding: Where a 14-day running average is established, the average daily OMR flow must be no more negative than the required OMR flow. Where a 5-day running average is given, the daily average shall be no more than 25 percent more negative than the requirement. The daily OMR flows used to compute both the 14-day and the 5-day averages shall be the "tidally filtered" values reported by USGS.

Low-entrainment risk period: delta/longfin smelt salvage has historically been low between December 1 and December 19, even during periods when first flush conditions (i.e., elevated river inflow and turbidity) occurred. During the low-entrainment risk period, the SWG shall determine if the information generated by physical (i.e. turbidity and river inflow) and biological (e.g., salvage, DFG trawls) monitoring indicates that delta/longfin smelt are vulnerable to entrainment or are likely to migrate into a region where future entrainment events may occur. If this occurs, USFWS or DFG shall require initiation of Action 1 as described in Attachment B. Action 1 shall require the Projects to maintain OMR flows no more negative than -2,000 cfs (14-day average) with a simultaneous 5-day running average flow no more negative than -2,500 cfs to protect adult delta/longfin smelt for 14 days.

High-entrainment risk period: delta/longfin smelt have historically been entrained when first flush conditions occur in late December. In order to prevent or minimize such entrainment, Action 1 shall be initiated on or after December 20 if the three day average turbidity at Prisoner's Point, Holland Cut, and Victoria Canal exceeds 12 NTU, or if there are three days of delta/longfin smelt salvage at either facility or if the cumulative daily salvage count is above the risk threshold based upon the "daily salvage index" approach described in Attachment B. Action 1 shall require the Projects to maintain OMR flows no more negative than -2,000 cfs (14-day running average) with a simultaneous 5-day running average flow no more negative than -2,500 cfs to protect adult delta/longfin smelt for 14 days. However, the SWG can recommend a delayed start or interruption based on other conditions such as delta inflow that may affect vulnerability to entrainment.

Winter protection period: recent analyses indicate that cumulative adult entrainment and salvage are lower when OMR flows are no more negative than -5,000 cfs in the December through March period. Action 2 shall commence immediately after Action 1 ends. If Action 1 is not implemented, the SWG may recommend a start date for the implementation of Action 2 to protect adult delta/longfin smelt. OMR flows under Action 2 shall be in the range of -3,500 to -5,000 when turbidity and salvage are low. Based on historic conditions, OMR flow would generally be expected to be in the range of -2,000 cfs to -3,500 cfs given recent salvage events. However, at times when turbidity and flow conditions in the Delta may result in increased salvage, the range may be between -1,250 to -2,000 cfs. During the implementation of the action, the maximum negative flow for OMR shall be determined based on the criteria outlined in Attachment B. The OMR flow shall be based on a 14-day running average with simultaneous 5-day running average within 25 percent of the required OMR flow. The action may be suspended temporarily if the three day flow average is greater than or equal to 90,000 cfs at the Sacramento River at Rio Vista and 10,000 cfs at the San Joaquin River at Vernalis, because there is low likelihood that delta/longfin smelt will be entrained during such high inflow conditions. Suspension of this action due to high flow will end when flow drops below the 90,000 cfs and 10,000 cfs threshold. Action 2 ends when spawning begins as defined for Action 3 implementation (Component 2).

3.12.3 RPA Component 2: Protection of Larval and Juvenile Delta and Longfin Smelt

Delta and longfin smelt larvae and juveniles are susceptible to direct mortality by entrainment. Hydrologic conditions resulting from CVP/SWP operations increase the risk of that entrainment. The objective of this RPA component (which corresponds to Action 3 in Attachment B), is to improve flow conditions in the Central and South Delta so that larval and juvenile delta/longfin smelt can successfully rear in the Central Delta and move downstream when appropriate.

Upon completion of RPA Component 1 or when Delta water temperatures reach 12˚C (based on a three-station average of daily average water temperature at Mossdale, Antioch, and Rio Vista) or when a spent female delta/longfin smelt is detected in the trawls or at the salvage facilities, the projects shall operate to maintain OMR flows no more negative than -1,250 to -5000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25 percent of the applicable 14-day OMR flow requirement. Depending on the extant conditions, the SWG shall make recommendations for the specific OMR flows within this range from the onset of implementing RPA Component 2 through its termination. USFWS and DFG shall make the final determination regarding specific OMR flows. This action shall end June 30 or when the 3-day mean water temperature at CCF reaches 25° C, whichever occurs earlier.

The Spring Head of Old River Barrier (HORB) shall be installed only if USFWS determines delta/longfin smelt entrainment is not a concern (Action 5 from Attachment B).

3.12.4 RPA Component 5: Monitoring and Reporting

Reclamation and DWR shall ensure that information is gathered and reported to ensure that:

1) These actions are proper implemented,
2) The physical results of these actions are achieved, and
3) Information is gathered to evaluate the effectiveness of these actions on the targeted life stages of delta/longfin smelt so that the actions can be refined, if needed.

Essential information to evaluate these actions (and the Incidental Take Statement) includes sampling of the Fall Midwater Trawl (FMWT), Spring Kodiak Trawl, 20-mm Survey, Summer Townet Survey (TNS) and the Environmental Monitoring Program of the Interagency Ecological Program (IEP). This information shall be provided to USFWS and DFG within 14 days of collection. Additional monitoring and research will likely be required, as defined by the adaptive management process.

Information on salvage at Banks and Jones is both an essential trigger for some of these actions and an important performance measure of their effectiveness. In addition, information on OMR flows and concurrent measures of delta/longfin smelt distribution and salvage are essential to ensure that actions are implemented effectively. Such information shall be included in an annual report for the WY (October 1 to September 30) to USFWS and DFG, provided no later than October 15 of each year, starting in 2010.

DWR shall implement these actions based on performance standards, monitoring and evaluation of results from the actions undertaken . Some of the data needed for these performance measures are already being collected such as the FMWT abundances and salvage patterns. However, more information on the effect of these actions on smelt survival and the interactions of project operations with other stressors on delta/longfin smelt health, fecundity and survival is needed. This information may provide justification for refining these actions to better address the needs of delta/longfin smelt. Studies like those of the IEP's POD workteam have provided much useful information on the needs of delta/longfin smelt and the stressors affecting them that was integral in the development of these actions.

3.12.5 Delta and Longfin Smelt Risk Assessment Matrix (SRAM)

The SWG will employ delta and longfin smelt risk assessment matrices to assist in evaluating the need for operational modifications of SWP and CVP to protect delta/longfin smelt. The currently approved DSRAM is Attachment A of the 2008 USFWS BO. These documents will be tools of the SWG and will be modified by the SWG with the approval of USFWS and DFG, in consultation with DWR as new knowledge becomes available. If an action is taken, the SWG will follow up on the action to attempt to ascertain its effectiveness. The ultimate decision-making authority rests with USFWS and DFG for longfin smelt. An assessment of effectiveness will be attached to the notes from the SWG's discussion concerning the action.

3.12.6 REAL TIME FLOW PRESCRIPTIONS

The following actions will be implemented for the protection of longfin smelt as determined per the process described above (as modified from the 2008 USFWS BO Attachment B).

3.12.6.1 ACTION 1: ADULT MIGRATION AND ENTRAINMENT (FIRST FLUSH)

Objective: A fixed duration action to protect pre-spawning adult delta/longfin smelt from entrainment during the first flush, and to provide advantageous hydrodynamic conditions early in the migration period.

Action: Limit exports so that the average OMR flow[1] is no more negative than - 2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,400 cfs (within 20%).

Timing:

Part A: December 1 to December 20 – Based upon an examination of turbidity data from Prisoner's Point, Holland Cut, and Victoria Canal and salvage data from CVP/SWP (see below), and other parameters important to the protection of delta/longfin smelt including, but not limited to, preceding conditions of X2, FMWT, and river flows; the SWG may recommend a start date to USFWS. USFWS and DFG will make the final determination.

Part B: After December 20 – The action will begin if the three day average turbidity at Prisoner's Point, Holland Cut, and Victoria Canal exceeds 12 NTU. However the SWG can recommend a delayed start or interruption based on the turbidity three day average not being met, or variation in other conditions such as delta inflow that may affect vulnerability to entrainment.

Triggers (Part B):

Turbidity: Three-day average of 12 NTU or greater at *all three* stations (Prisoner's Point, Holland Cut, and Victoria Canal)

OR

Salvage: Three days of delta/longfin smelt salvage at either facility or cumulative daily salvage count that is above a risk threshold based upon the "daily salvage index" approach reflected in a daily salvage index value ≥ 0.5 (daily delta/longfin smelt salvage > one-half prior year FMWT index value).

The window for triggering Action 1 concludes when either off ramp condition described below is met. These off ramp conditions may occur without Action 1 ever being triggered. If this occurs, then Action 3 is triggered[2], unless USFWS and DFG conclude on the basis of the totality of available information that Action 2 should be implemented instead.

Off-ramps:

Temperature: Water temperature reaches $12^{o}C$ based on a three station daily mean at Mossdale, Antioch, and Rio Vista

OR

Biological: Onset of spawning (presence of spent females in SKT or at Banks or Jones).

[1] OMR Flows for this and all relevant actions will be measured at the Old River at Bacon Island and Middle River at Middle River stations, as has been established already by the Interim Order.

[2] The off ramp criteria for Actions 1 and 2 to protect adults from entrainment are identical to the initiation triggers for Action 3 to protect larval/juveniles from entrainment

3.12.6.2 ACTION 2: ADULT MIGRATION AND ENTRAINMENT

Objective: An action implemented using adaptive management to tailor protection to changing environmental conditions after Action 1. As in Action 1, the intent is to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions.

Action: The range of OMR flows will be no more negative than -1,250 to -5,000 cfs. Depending on extant conditions (and the general guidelines below) specific OMR flows within this range are recommended by the SWG from the onset of Action 2 through its termination. The SWG would provide weekly recommendations based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. USFWS and DFG will make the final determination.

Timing: Beginning immediately after Action 1. Before this date (in time for operators to implement the flow requirement) the SWG will recommend specific requirement OMR flows based on salvage and on physical and biological data on an ongoing basis.

Suspension of Action:

> *Flow:* OMR targets do not apply whenever a three day flow average is greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and 10,000 cfs in San Joaquin River at Vernalis. Once such flows have abated, the OMR flow requirements of the Action are again in place.

Off-ramps:

Temperature: Water temperature reaches 12°C based on a three station daily average (Rio Vista, Antioch, Mossdale)

OR

Biological: Onset of spawning (presence of spent females in SKT or at either facility)

Adaptive Management Required Parameters:

Two scenarios span the range of circumstances likely to exist during Action 2. First, the low-entrainment risk scenario. There may be a low risk of adult entrainment because (a) there has been no discernable migration of adults into the South and Central Delta; or (b) the upstream migration has already occurred but turbidity is low and there is no or little evidence of ongoing adult entrainment. In this scenario, higher negative OMR flow rates as high as -5,000 cfs may be ventured as long as entrainment risk factors and salvage permit.

The second scenario, the high-entrainment risk scenario, is one in which either (a) there is evidence that upstream adult migration is currently occurring; or (b) upstream migration has already occurred and there are adult fish in the South and Central Delta and turbidity is high, increasing the risk of entrainment; or (c) there is evidence of ongoing entrainment, regardless of other risk factors. In this case, OMR will be set to reduce entrainment and/or the risk of entrainment as the totality of circumstances warrant.

Generally, if the available distributional information suggests that most delta/longfin smelt are in the North or North/Central Delta, then OMR can be chosen to minimize Central Delta entrainment. However, if the distributional information suggests there are delta/longfin smelt in the Central or South Delta, then OMR will have to be set lower to reduce entrainment of delta/longfin smelt.

The following describes how these action guidelines would be implemented at the start of Action 2 and at other times during Action 2.

1. OMR setting at initiation of Action 2

a) If salvage is zero during the final 7 days of Action 1, and three station mean turbidity is below 15 NTU, then increase negative OMR to no more negative than -5,000 cfs on a 14-day running average with a simultaneous 5-day running average within 20% of the applicable target OMR[3];

UNLESS

b) If salvage is less in the most recent three days than in the preceding three days of Action 1, and the maximum Daily Salvage Index is ≤1 during the prior 7 days, then limit exports to achieve OMR flows no more negative than -3,500 cfs on a 14-day running average for 7 more days (or until 4 consecutive days of zero salvage or any 5 of 7 days with zero salvage), with a 5-day running average within 20 percent of the applicable requirement OMR;

OR

c) If salvage is greater or equal in the last three days than in the preceding three days of Action 1, and maximum Daily Salvage Index ≥1 during any of those days, then continue OMR flow at no more negative than -2,000 cfs on a 14-day running average for an additional 14 days (or until 4 succeeding days of zero salvage or any 5 of 7 days zero salvage), with a simultaneous 5-day running average within 20 percent of the applicable requirement OMR;

OR

d) If circumstances existing at the initiation of Action 2 are, in the judgment of USFWS, markedly different from those anticipated in (a) through (c) above, then the OMR flow

[3] The 5-day running average is calculated from actual daily OMR values, not from averaged OMR values computed using the seven day running average described previously.

requirement in (c) will be applied and the SWG will review available data and recommend an initial flow rate to USFWS and DFG.

2. OMR setting after initiation of Action 2

a) The SWG will review all available information and request updated entrainment simulations and/or other information, as needed, on a weekly basis to decide whether the current OMR requirement is appropriate or should be changed.

b) Unless OMR is grossly positive regardless of water project operations, due to high Delta tributary river discharges, then important variables that affect the risk of adult entrainment during Action 2 include (1) salvage or other actual entrainment indicators, (2) turbidity, (3) available monitoring results, hydrologic variables other than export pumping rates that affect OMR flow, (4) apparent population size from the preceding FMWT survey, (5) particle tracking or other model-based entrainment risk information.

c) As described above, the risk of entrainment is generally higher when there is evidence of ongoing entrainment or turbidity is high, and these two variables are the most likely triggers of decisions to raise or lower OMR flow requirements.

d) Based on historical experience, OMR flow requirements between the limits of -2,000 cfs and -5,000 cfs is likely to be adequate in most years. The exception is a year in which there appears, for whatever reasons, to be a substantial fraction of the adult spawning migrant population in the Central and/or South Delta. When this occurs, more stringent OMR limitation (possibly to no more negative than - 1,250 cfs) may be required.

3.12.6.3 ACTION 3: ENTRAINMENT PROTECTION OF LARVAL SMELT

Objective: Minimize the number of larval delta/longfin smelt entrained at the facilities using VAMP-like flow levels and export reductions spanning a time sufficient for protection of larval delta/longfin smelt. Because protective OMR flow requirements vary over time (especially between years), the action is adaptive and flexible within appropriate constraints.

Action: OMR will be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average within 20 percent of the applicable requirement OMR.[4] Depending on extant conditions (and the general guidelines below) specific OMR flows within this range are recommended by the SWG from the onset of Action 2 through its termination (see Adaptive Management Process).[5] The SWG would provide these recommendations based upon weekly review of sampling data, from real-time salvage data at the

[4] The 5-day running average is calculated from actual daily OMR values, not from averaged OMR values computed using the seven day running average described previously.

[5] During most conditions, it is expected that maximum negative OMR flows will range between -2000 and -3500. During certain years of higher or lower predicted entrainment risk, requirements as low as - 1,250 or -5,000 will be recommended to USFWS by the SWG

CVP/SWP, and expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. USFWS and DFG will make the final determination.

Timing: Initiate the action twenty days after reaching the triggers below, which are indicative of spawning activity and the probable presence of larval delta/longfin smelt in the South and Central delta. During the twenty days between the end of actions 1 and/or 2 and all intervening days thereafter, OMR flow will be set at no more negative than -5,000 cfs on a 14-day running average with a five-day running average (computed from actual daily OMR values) not more negative than the requirement by more than twenty percent. Based upon daily salvage data, the SWG may recommend an earlier start to Action 3. USFWS and DFG will make the final determination.

Triggers:

Temperature: When temperature reaches 12°C based on a three station average at Mossdale, Antioch, and Rio Vista.

OR

Biological: Onset of spawning (presence of spent females in SKT or at either facility).

Offramps:

Temporal: June 30;

OR

Temperature: Water temperature reaches a daily average of 25°C for three consecutive days at CCF.

Adaptive Management Required Parameters:

During the larval/juvenile entrainment risk period, the SWG will meet weekly to review available physical and biological data and develop a recommendation to USFWS. USFWS and DFG will determine the specific OMR requirement based upon the SWG recommendation and the strength of the accompanying scientific justification.

Two scenarios span the range of circumstances likely to exist during Action 3. First, the low-entrainment risk scenario. There may be a low risk of larval/juvenile entrainment because there has been no evidence of delta/longfin smelt in the South and Central Delta. In this scenario, negative OMR flow rates as high as -5,000 cfs may occur as long as entrainment risk factors permit.

The second scenario, the high-entrainment risk scenario, is one in which either: a) there is evidence of delta/longfin smelt in the South and Central Delta from the SKT and/or 20mm survey; or (b) there is evidence of ongoing entrainment, regardless of other risk factors. In this case, OMR should be set to reduce entrainment and/or the risk of entrainment as the totality of circumstances warrant.

Usually, if the available distributional information suggests that most delta/longfin smelt are in the North or North/Central Delta, then OMR can be chosen to minimize Central Delta entrainment. However, if the distributional information suggests there are delta/longfin smelt in the Central or South Delta, then OMR will have to be set lower to reduce entrainment of these fish. If delta/longfin smelt abundance is low, distribution cannot be reliably inferred. Therefore, the adaptive management process is extremely important. The SWG may recommend any specific running average OMR requirement within the specified range above.

3.12.6.4 ACTION 5: TEMPORARY SPRING HEAD OF OLD RIVER BARRIER (HORB)AND THE TEMPORARY BARRIER PROJECT (TBP)

Objective: To minimize entrainment of larval and juvenile delta/longfin smelt at Banks and Jones or from being transported into the South and Central Delta, where they could later become entrained.

Action: Do not install the HORB if delta/longfin smelt entrainment is a concern. If installation of the HORB is not allowed, the agricultural barriers would be installed as described above. If installation of the HORB is allowed, the TBP flap gates would be tied in the open position until May 15.

Timing: The timing of the action would vary depending on the conditions. The normal installation of the spring temporary HORB and the TBP is in April.

Triggers: For delta/longfin smelt, installation of the HORB will only occur when PTM results show that entrainment levels of delta/longfin smelt will not increase beyond 1 percent at Station 815 as a result of installing the HORB.

Offramps: If Action 3 ends or May 15, whichever comes first.

DWR shall ensure that information is gathered and reported to ensure that: (1) proper implementation of these actions; (2) the physical results of these actions are achieved; and (3) information is gathered to evaluate the effectiveness of these actions on the targeted life stages of delta/longfin smelt so that the actions can be refined, if needed. Essential information to evaluate these actions (and the Incidental take Statement) includes sampling of the FMWT, the 20-mm Survey and the Environmental Monitoring Program of the IEP. This information shall be provided to USFWS and DFG within 14 days of collection.

Information on salvage at both facilities is both an essential trigger for some of these actions and an important performance measure of their effectiveness. In addition, information on OMR flows and concurrent measures of delta/longfin smelt distribution and salvage are essential to ensure that actions are implemented effectively. Such information shall be included in an annual report to USFWS and DFG.

DWR shall implement these action based on performance standards, monitoring and evaluation of results from the actions undertaken and adaptive management as described in RPA component

3. RPA component 3 has a robust adaptive management component that is a separate analysis than this component. Some of the data needed for these performance measures are already being collected such as the FMWT abundances and salvage patterns. However, more information on the effect of these actions on smelt survival and the interactions of project operations with other stressors on delta/longfin smelt health, fecundity and survival is needed to refine these actions to better address the needs of delta/longfin smelt. Studies like those of the IEP's POD workteam have provided much useful information on the needs of delta/longfin smelt and the stressors affecting them that was integral in the development of these actions.

4.0 Additional Factors Potentially Influencing the Abundance and Distribution of Longfin Smelt

In addition to potential direct and indirect effects on longfin smelt associated with SWP facilities, there are various additional factors potentially influencing the abundance and distribution of longfin smelt. The POD 2007 Synthesis Report (IEP 2007, *as cited in* Reclamation 2008) uses four categories in their conceptual model to describe mechanisms which could produce the observed Delta pelagic fish declines. The four major components include: (1) prior fish abundance; including stock-recruitment; (2) habitat conditions, including physical and chemical variables, disease and localized toxic algal blooms; (3) top-down effects, including predation, entrainment and other processes that cause juvenile and adult mortality; and (4) bottom-up effects, including food web interactions; these factors are summarized below. For further discussion of these factors and their influence on the longfin smelt population, see Reclamation (2008).

4.1 Prior Abundance

Various types of stock recruitment relationships exist, including density-independent, density-dependent and density vague. There is a point at which low adult stock will result in low juvenile abundance and subsequent low recruitment to future adult stocks even under favorable environmental conditions while the stock "rebuilds itself" (Reclamation 2008). However, there has been no demonstrated stock-recruitment relationship for longfin smelt in the San Francisco Estuary.

4.2 Habitat Conditions

The existing habitat and hydrodynamics of the Bay-Delta region have changed substantially from the environment in which native fish species such as longfin smelt evolved. Prior to habitat modifications, such as channelization and conversion of Delta islands to agriculture, the Delta consisted of tidal marshes with networks of diffuse dendritic channels connected to floodplains of wetlands and upland areas (Moyle 2002). Prior to the introduction of upstream reservoirs, freshwater inflow to the Delta was much better correlated with precipitation patterns than it is today. Operations of upstream reservoirs have reduced spring flows to the Delta, while releases of water for Delta export and to meet fall flood control criteria in upstream reservoirs have increased late summer and fall inflows (Knowles 2002, *as cited in* Reclamation 2008). However, Delta outflows have been tightly constrained during late-summer and fall for several decades (Reclamation 2008). Due to the altered patterns of inflow to the Delta and habitat modification, seasonal and annual variation in hydrology, salinity, turbidity, and other characteristics of the Delta ecosystem was greater historically than it is today (Kimmerer 2002b, *as cited in* Reclamation 2008).

Habitat for longfin smelt is open water, largely away from shorelines and vegetated inshore areas except potentially during spawning (Reclamation 2008). These areas include Suisun Bay and the deeper areas of many of the larger channels in the Delta. Longfin smelt habitat includes water with suitable values for a variety of physical-chemical properties, including salinity, turbidity, and temperature, suitably low levels of contaminants, and suitably high levels of prey production (Reclamation 2008). Changes in longfin smelt habitat quality can be indexed by changes in X2.

X2 is a strong predictor of the longfin smelt FMWT index, suggesting flow and its affect on habitat are strong determinants of longfin smelt abundance (Reclamation 2008).

4.3 Top Down Effects

4.3.1 Reduced Turbidity

The observed change in Bay-Delta turbidity has the potential, in combination with other factors, such as non-native species, to fundamentally alter the trophic dynamics of the estuary for species such as longfin smelt. Based on the similarities in life history, seasonal and geographic distribution, pelagic foraging and diet, it has been hypothesized that longfin smelt may have a similar relationship to turbidity as that observed for delta smelt (S. Foott unpublished data, R. Baxter pers. Comm. *as cited in* SAIC 2008). Enlarged olfactory organs in longfin smelt (found in both larvae, juveniles, and in the "triangle" swimbladder of larvae [USFWS 2008b]) suggest that they are well adapted to high turbidity conditions during foraging. As a result, longfin smelt may lose their competitive advantage in foraging to other zooplanktivores when turbidity is low (SAIC 2008).

Turbidity has decreased over the past several decades in the Delta as a result of a variety of factors (Kimmerer 2004, Feyrer et al. 2007, Fullerton 2007 *as cited in* SAIC 2008). First, upstream sediment inputs have been reduced due to a range of anthropogenic actions (Jassby et al. 2002, Kimmerer 2004 *as cited in* SAIC 2008), river bank protection, levee construction that reduced flood plain inundation and channel meanders, and changes in land use (Wright and Schoellhamer 2004 *as cited in* SAIC 2008). Wright and Schoellhamer (2004 *as cited in* SAIC 2008) estimated that the yield of suspended sediments from the Sacramento River declined by approximately one half from 1957 to 2001.

Second, the distribution and abundance of non-native aquatic plant species, particularly *Egeria* and water hyacinth, has increased dramatically over the past 20 years (Nobriga et al, Brown and Michniuk 2007 *as cited in* SAIC 2008). Both plants can reduce turbidity by reducing water velocity and trapping fine suspended sediments (Grimaldo and Hymanson 1999, Jassby et al. 2002, Nessor et al. 2003, Hobbs et al. 2006 *as cited in* SAIC 2008).

Third, the high filtering efficiency of the overbite clam has dramatically reduced phytoplankton and zooplankton abundance in the western Delta and Suisun Bay since its introduction (Kimmerer and Orsi 1996, Jassby et al. 2002, Kimmerer 2002b, 2004 *as cited in* SAIC 2008). The reduction in phytoplankton in the water column may contribute to increased water clarity and reduced turbidity in the Delta (SAIC 2008).

Fourth, hydraulic residence in the Delta has declined as a result of increased channelization and the movement of water from the Sacramento River into the interior Delta channel to improve water quality and provide increased supplies to in-Delta exports. SWP and CVP export operations have also directly resulted in changes in the hydrodynamics within Delta channels such as Old and Middle rivers which affect hydraulic resident time. Reduced hydraulic residence time reduced the ability of phytoplankton and bacteria to incorporate nutrients and carbon (Jassby et al. 2002, Kimmerer 2002a, 2004, Resource Agency 2007 *as cited in* SAIC 2008). This reduction in phytoplankton and zooplankton production contributes directly to reduced turbidity within the Bay-Delta estuary (SAIC 2008).

4.3.2 Contaminants and Disease

Contaminants can change ecosystem functions and productivity through numerous pathways. The trends in contaminant loadings and their ecosystem effects are not well understood and current efforts are underway to evaluate direct and indirect toxic effects on the POD fishes of both man-made contaminants and natural toxins associated with blooms of *M. aeruginosa* (a cyanobacterium or blue-green alga). The main indirect contaminant effect being investigated is inhibition of prey production.

Phytoplankton growth rate may occasionally be inhibited by high concentrations of herbicides (Edmunds et al. 1999 *as cited in* Reclamation 2008). New evidence indicates that phytoplankton growth rate may at times be inhibited by ammonium concentrations in and upstream of Suisun Bay (Wilkerson et al. 2006, Dugdale et al. 2007, Dugdale et al unpublished *as cited in* Reclamation 2008). Toxicity to invertebrates has been noted in water and sediments from the Delta and associated watersheds (e.g., Kuivila and Foe 1995; Giddings 2000; Werner et al. 2000; Weston et al. 2004 *as cited in* Reclamation 2008). Undiluted drainwater from agricultural drains in the San Joaquin River watershed can be acutely toxic (quickly lethal) to fish and have chronic effects on growth (Saiki et al. 1992 *as cited in* Reclamation 2008).

POD investigators have also monitored blooms of the toxic cyanobacterium *Microcystis aeruginosa*. Large blooms of *M. aeruginosa* were first noted in the Delta in 1999 (Lehman et al. 2005 *as cited in* Reclamation 2008). Further studies (Lehman et al. in prep. *as cited in* Reclamation 2008) suggest that microcystins, the toxic chemicals associated with the algae, probably do not reach concentrations directly toxic to fishes, but during blooms, the microcystin concentrations may be high enough to impair invertebrates, which could influence prey availability for (Reclamation 2008).

In contrast, preliminary histopathological analyses have found evidence of significant disease in other species and for POD species collected from other areas of the estuary. Massive intestinal infections with an unidentified myxosporean were found in yellowfin goby *Acanthogobius flavimanus* collected from Suisun Marsh (Baxa et al. in prep. *as cited in* Reclamation 2008). Severe viral infection was found in inland silverside *Menidia beryllina* and juvenile delta smelt collected from Suisun Bay during summer 2005 (Baxa et al. in prep. *as cited in* Reclamation 2008).

Few studies have directly addressed how toxic chemicals, disease, and parasites affect longfin smelt. One of the few that does is an unpublished study by Scott Foott (DFG), who summarizes the work as follows (Reclamation 2008):

> Larval and 0+ juvenile Longfin smelt (LFS) and Threadfin shad (TFS) were collected in 2006 and 2007 from April – November. Over 400 fish/yr were assayed for virus using up to 4 different cell lines. Other fish were processed for histological examination (Davidson’s fixative, 6μm paraffin sagittal sections, H&E or PAS stain) of 10 target tissues (gill, liver, kidney, acinar tissue, intestinal

tract, heart, brain, eye, olfactory organ, and epidermis). The histological sample set in 2006 was composed of 15 TFS and 142 LFS while 118 TFS and 86 LFS histological specimens were examined in 2007.

Trematodes and cestodes were observed in 8-16% of intestines without associated tissue damage. Varying degrees of hepatocyte vacuolation was observed in a majority of LFS livers (July – November 2006 and 2007). PAS stain showed little glycogen and we speculate the vacuoles primarily contain fat. Fatty change can be associated with contaminate exposure. Interpretation is complicated by signs of tissue hypoxia in many specimens (outcome of capture stress prior to fixation?).

Summary: no significant health problem was detected in either TFS or LFS juveniles in 2006 or 2007. No virus was isolated in over 800 samples and the low incidence of parasitic infection was not associated with tissue damage or inflammation. In both 2006 and 2007, hepatocyte vacuolation was seen in many juvenile LFS livers from fish collected primarily in the fall. It is unknown whether fatty liver is normal for LFS or associated with toxic insults.

4.3.3 Exposure to Toxics

Exposure of longfin smelt to toxic substances can result from point and non-point sources associated with agricultural, urban, and industrial land uses. Longfin smelt would potentially be exposed to these toxic materials during their period of residence within the Delta. There are known studies that directly link mortality of longfin smelt with exposure to toxic chemicals within the Bay –Delta estuary (S. Foott unpublished data, R. Baxter pers. Comm.., Resources Agency 2007 *as cited in* SAIC 2008). However, longfin smelt spawn during winter months when non-point runoff of pesticides tends to be the greatest. The pesticide diazinon is known to reduce growth and increase spinal deformities in Sacramento splittail (Teh et al. 2004 *as cited in* SAIC 2008), but effects of diazinon on longfin smelt have not been investigated. Reports during January 1997 indicated that flooding along the Feather River dispersed fuel and agricultural chemicals into the water column during a period when longfin smelt larvae were hatching in high numbers; the subsequent 1997 year class was low given the high winter outflow however a direct cause and effect linkage with exposure to toxics was not documented (SAIC 2008).

The short life span (<3 years) and location of their food source in the food web (zooplankton are primary consumers) reduce the ability of toxic chemicals to bioaccumulate in the tissue of longfin smelt (Moyle 2002 *as cited in* SAIC 2008). Their location in the water column may further reduce the probability of some toxic impacts by those chemicals that are sequestered quickly by sediments (i.e., pyrethroids; B. Herbold pers. comm.. *as cited in* SAIC 2008).

There is growing evidence that invertebrate prey of longfin smelt are affected by toxics (Weston et al. 2004, Luoma 2007, Werner 2007 *as cited in* SAIC 2008), suggesting that toxics may indirectly impact longfin smelt by reducing food availability. Further, toxics may cause sublethal impacts to longfin smelt that make them more vulnerable to other sources of mortality (Werner 2007 *as cited in* SAIC 2008). Clifford et al. (2005 *as cited in* SAIC 2008) found that esfenvalerate, a common pyrethroid, increased the susceptibility of juvenile fall-run Chinook salmon to infectious hematopoietic necrosis virus. It is possible that toxics have similar interactive effects with other stressors to longfin (SAIC 2008).

4.3.4 Climate Change

There is gathering evidence that, in the San Francisco Bay-Delta Estuary habitat of longfin smelt, the effects of climate change will manifest as (SAIC 2008):

(1) Sea level rise and accompanying salinity intrusion;
(2) Changes in timing and amounts of freshwater inflow; and
(3) Increased frequency and intensity of floods (CCAT 2006, *as cited in* The Bay Institute et al. 2007).

Sea level rise and salt water intrusion higher into the estuary will shift the interface between inflowing fresh water and saline water from the Bay further upstream in the Estuary, a condition known to adversely affect estuarine habitat quality for delta smelt and striped bass (Feyrer et al. 2005, 2006; Guerin et al. 2006, *as cited in* The Bay Institute et al. 2007). Increases in air temperature in the Estuary's high elevation watershed is predicted to reduce the volume of the snow pack (i.e., more precipitation will fall as rain rather than snow) and accelerate snowmelt (earlier snowmelt timing in the Sacramento-San Joaquin watershed is already detectable). These changes will result in more frequent and larger flood events, which will likely affect longfin smelt habitat by increasing freshwater inflows during the winter and early spring rather than the late springtime freshwater inflows to which the species is adapted. In addition, these changes will have substantial effects on water management operations in the watershed and Estuary, including the amounts and timing of upstream storage releases (and resultant Delta inflows), changes in carryover storage amounts (and the ability to provide habitat maintenance flows in sequential dry years), and Delta exports (Anderson 2006; Easton and Ejeta 2006, *as cited in* The Bay Institute et al. 2007).

4.3.5 Non-Native Species

The effect of non-native predators, such as inland silversides, largemouth bass, striped bass, and other fish on the longfin smelt populations is largely unknown, but may be important (Bennett and Moyle 1996, Moyle 2002 *as cited in* SAIC 2008). Predator-prey dynamics in the San Francisco Estuary are poorly understood, but are currently receiving considerable research attention by the IEP as part of the POD investigation (Reclamation 2008).

For example, while largemouth bass are not pelagic, their presence at the boundary between the littoral and pelagic zones makes it probable that they do opportunistically consume pelagic fishes. Analyses of fish salvage data show this increase occurred somewhat abruptly in the early 1990s and has been sustained since. The increase in salvage of largemouth bass occurred during the time period when *E. densa*, an introduced aquatic macrophyte was expanding its range in the Delta (Brown and Michniuk 2007 *as cited in* Reclamation 2008). The habitat provided by beds of *E. densa* provide good habitat for largemouth bass and other species of centrarchids. Thus, the increased abundance of this introduced predator was likely caused by an increase in an introduced plant, which provided favorable habitat. The areal coverage of *E. densa* in the Delta continued to expand by more than 10% per year from 2004 to 2006, by infesting a greater portion of channels and invasion of new habitat (E. Hestir et al., U.C. Davis, unpublished data *as* *cited in* Reclamation 2008). This suggests that populations of largemouth bass, other piscivorous and other non-pisciverous species using submerged aquatic vegetation will continue to increase (Reclamation 2008).

The introductions *of E. densa* and other highly invasive and fast growing aquatic plants, such as water hyacinth, have not shown population level effects on longfin smelt (Nobriga et al. 2005 *as cited in* SAIC 2008). These aquatic plants may have had other potentially detrimental impacts to longfin smelt, including competition, with native vegetation and reducing dissolved oxygen concentrations and turbidity within their immediate vicinity (Grimaldo and Hymanson 1999, Brown and Michniuk 2007, Feyrer et al. 2007 *as cited in* SAIC 2008).

The overbite clam has caused dramatic changes to the composition and abundance of the phytoplankton and zooplankton communities in the aquatic food web since its introduction into the Bay-Delta estuary (Kimmerer and Orsi 1996 *as cited in* SAIC 2008). Kimmerer (2002a *as cited in* SAIC 2008) asserted that these changes likely reduced food availability for a large assemblage of organisms, leading to reduced recruitment success of longfin smelt and four-fold reduction in the abundance of longfin smelt (Rosenfield and Baxter, in press *as cited in* SAIC 2008).

4.4 Bottom-Up Effects

Kimmerer (2002b, *as cited in* Rosenfield and Baxter 2007) suggested that the decline in the estuary's longfin smelt population relates to declines in the availability of food items following the introduction of the filter-feeding Amur clam in 1986. Rosenfield and Baxter (2007) concluded that food limitation is consistent with their finding of reduced age-class 1 productivity and the disproportionate reduction in age-class 2 recruitment.

A significant long-term decline in phytoplankton biomass (chlorophyll a) and primary productivity has been observed in the Suisun Bay region and the lower Delta (Jassby et al. 2002, *as cited in* Reclamation 2008). However, phytoplankton trends for the most recent decade (1996-2005) are reportedly positive in the Delta and neutral in Suisun Bay (Jassby, in press, *as cited in* Reclamation 2008). Nevertheless, phytoplankton may play a role via changes in species composition (see Reclamation 2008). For example, shifts have occurred in phytoplankton species composition in the San Francisco Estuary from diatom dominated to more flagellate dominated communities (Lehman 1996, 2000, *as cited in* Reclamation 2008). One study found that one calanoid copepod species (*E. affinis*) gained the greatest nutritional benefit from varied food sources present in small tidal sloughs in Suisun Marsh, while a different copepod species (*P. forbesi*) benefited most from riverine phytoplankton in the southern Delta, particularly diatoms (Mueller-Solger et al. 2006, *as cited in* Reclamation 2008). Diatoms are likely also an important food source for other calanoid copepod species. The relative decline in diatoms among the phytoplankton community may help to explain the declines in *P. forbesi* and other calanoid copepod species (Reclamation 2008). Copepods and other crustaceans are reported to be important food items for longfin smelt, especially younger juveniles (Hobbs et al. 2006, *as cited in* Rosenfield and Baxter 2007). Older juveniles and adult longfin smelt primarily feed on opossum shrimp, *Acanthomysis* sp. and *Neomysis mercedis*, when available (Hobbs et al. 2006, *as cited in* Rosenfield and Baxter 2007). In addition to the reported decline in some copepod species, *Neomysis mercedis* has reportedly declined substantially in the estuary since the early 1970s (Orsi and Mecum 1996, *as cited in* Rosenfield and Baxter 2007).

Some aspects of the longfin smelt decline are not explained by food web changes related to the Amur clam introduction (Rosenfield and Baxter 2007). For example, a consistent decline in catches of prespawning adult (age-class 2) longfin smelt in Suisun Marsh occurred prior to the onset of the 1987-1994 drought or the Amur clam introduction (Rosenfield and Baxter 2007). Rosenfield and Baxter (2007) recommend that investigations be undertaken to evaluate potential changes in Suisun Marsh's carrying capacity for longfin smelt.

5.0 Salvage

5.1 Salvage of Longfin Smelt

In an effort to reduce environmental impacts of the SWP and CVP, fish are screened, collected and transported back to the Delta from both the State and Federal water projects at their points of diversion (Brown et al. 1996, *as cited in* Herbold et al. 2005). Every two hours samples of the screened fish are collected, identified, measured and counted; these counts are then multiplied to estimate the number of fish that were processed by the salvage operation (Herbold et al. 2005). The volume of water sampled by the salvage operation is greater than the volume of water sampled by any other sampling program so the numbers of fish sampled are often much greater. These data sets cover several decades and involve very frequent sampling. However, the sampling occurs at only two closely spaced geographic sites and species and population vulnerability varies greatly with variations in river flow and export operations and the distribution, size and abundance of fish species. Thus, it is often difficult to interpret patterns in the salvage dataset (Herbold et al. 2005).

Salvage numbers are a fraction of the number of fish entrained (Herbold et al. 2005). Fish less than 20mm in length are not effectively salvaged and are not included in estimates of salvage. In addition, pre-screen losses of longfin smelt are not available and information on screening efficiencies is very limited (Herbold et al. 2005). Thus, salvage is, at best, a rough index of annual and seasonal variability in the actual entrainment occurring at the facilities (Herbold et al. 2005).

Herbold et al. (2005) analyzed salvage data for several species, including longfin smelt, from both facilities for the years from 1994 to 2005 (**see Table 5-1, Figure 5-1**). Summarizing total salvage for each water year indicated little evidence of significant changes in the most recent years; most species peak annual salvage occurred between 2000 and 2002. In the late 1990s and 2000, salvage of several species increased when abundance in the FMWT increased (**see Table 5-2, Figure 5-2**). It was, therefore, somewhat surprising to see little evidence of a decline in salvage around 2002 when abundance in the FMWT Survey appeared to have declined by an order of magnitude (Herbold et al. 2005).

Table 5-1. Salvage Totals by Water Year for the Pelagic Species of Concern and Two Littoral Species

Year	Striped Bass	Threadfin Shad	Longfin Smelt	Delta Smelt	Inland Silversides	Centarchids
1994	2,455,514	1,786,433	6,411	43,580	59,364	169,101
1995	1,608,433	1,378,989	112	2632	73,754	253,755
1996	827,813	1,919,756	293	45,733	16,824	121,374
1997	1,507,075	3,625,153	1,132	43,931	40,806	281,983
1998	673,887	7,453,046	742	1269	95,569	141,851
1999	2,429,470	2,995,687	805	154,651	17,294	48,278
2000	3,523346	1,986,433	1,908	113,333	81,100	171,632
2001	2,234,087	10,488,542	6642	24,313	109,700	113,177
2002	1,546,861	5,862,902	97,734	66,548	109,811	97,947
2003	1,013,491	6,484,838	5,316	40,584	70,431	189,083
2004	813,669	6,026,905	981	20,589	54,539	196,735
2005	418,919	4,800,848	219	3,724	69,151	220,441

Source: Herbold et al. 2005

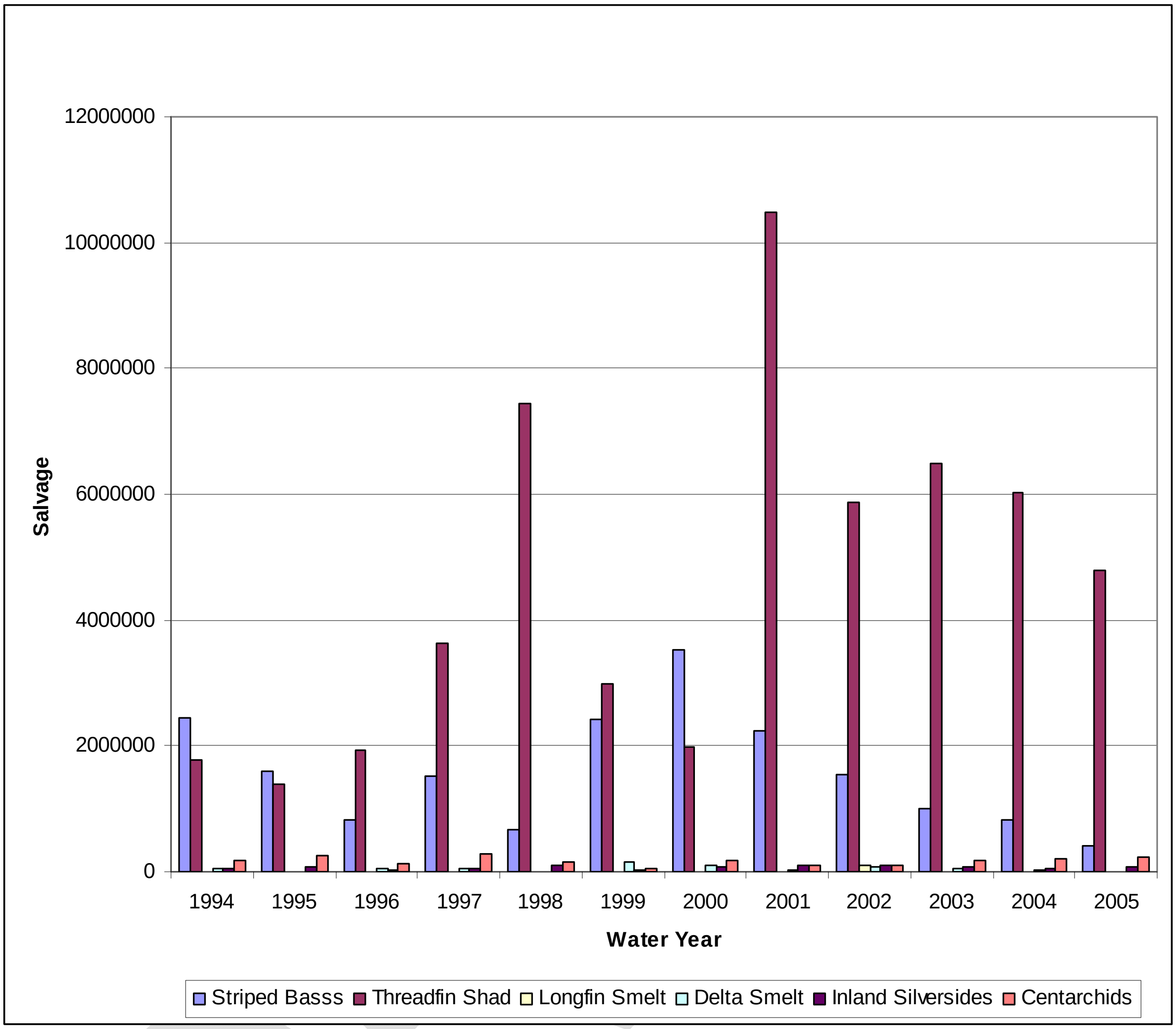


Figure 5-1. Salvage Totals by Water Year for the Pelagic Species of Concern and Two Littoral Species

Table 5-2. Abundance Indices for Pelagic Species in the Fall Midwater Trawl

Year	Striped Bass	Threadfin Shad	Longfin Smelt	Delta Smelt
1993	1557	6679	798	1078
1995	1259	2305	545	102
1996	484	3337	8646	899
1997	568	15268	690	303
1998	1224	5748	6654	420
1999	547	7527	5242	864
2000	390	12977	3438	756
2001	731	14402	247	603
2002	71	1753	707	139
2003	108	1956	191	210
2004	53	1301	190	74

Source: Herbold et al. 2005

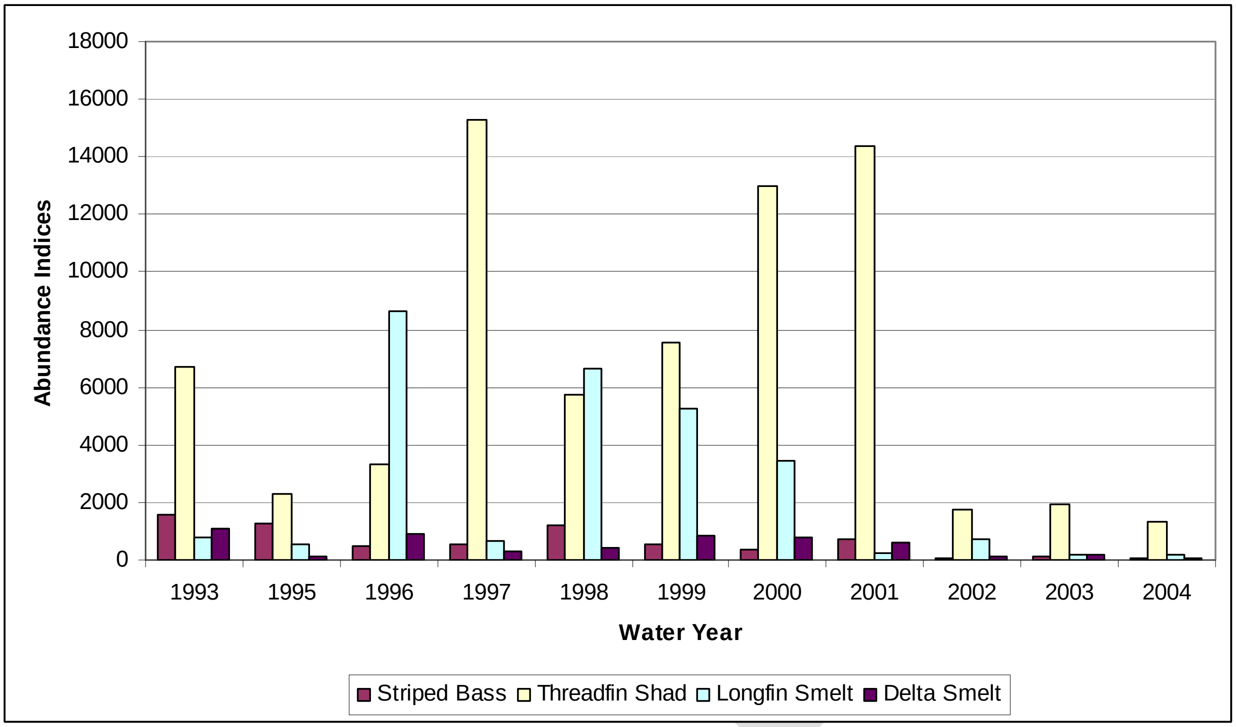


Figure 5-2. Abundance Indices for Pelagic Species in the Fall Midwater Trawl

Herbold et al. (2005) found that longfin smelt salvage during winter (November-March) showed a pattern of a strong increase in salvage despite sharp decreases in apparent abundance in the FMWT. **Figure 5-3** shows the total wintertime salvage, the salvage density (total salvaged/total amount of water exported Nov-Mar), and an index of longfin smelt salvage density in relation to abundance (the salvage density is divided by the preceding value of the FMWT).

Sharp increases in all three measures of wintertime salvage for all four species (including longfin smelt) are apparent for 2002-2005. For longfin smelt the first year of increased salvage, especially in relation to abundance, was 2002 (Herbold et al. 2005). These wintertime peaks are mostly comprised of the adults moving upstream to spawn.

For subadults and spawners, SWC (2008) computed the average longfin smelt salvage at the CVP and SWP Projects over a 15-year period (**see Figure 5-4 and Table 5-3**). The combined average longfin smelt salvage over the 15 year period was 8,202. Excluding 2002 data, the average salvage rate equates to 1,805 longfin smelt. The median annual salvages of all life stages for the Projects during 1993 through 2007, with and without 2002, were 805 and 746 longfin smelt, respectively.

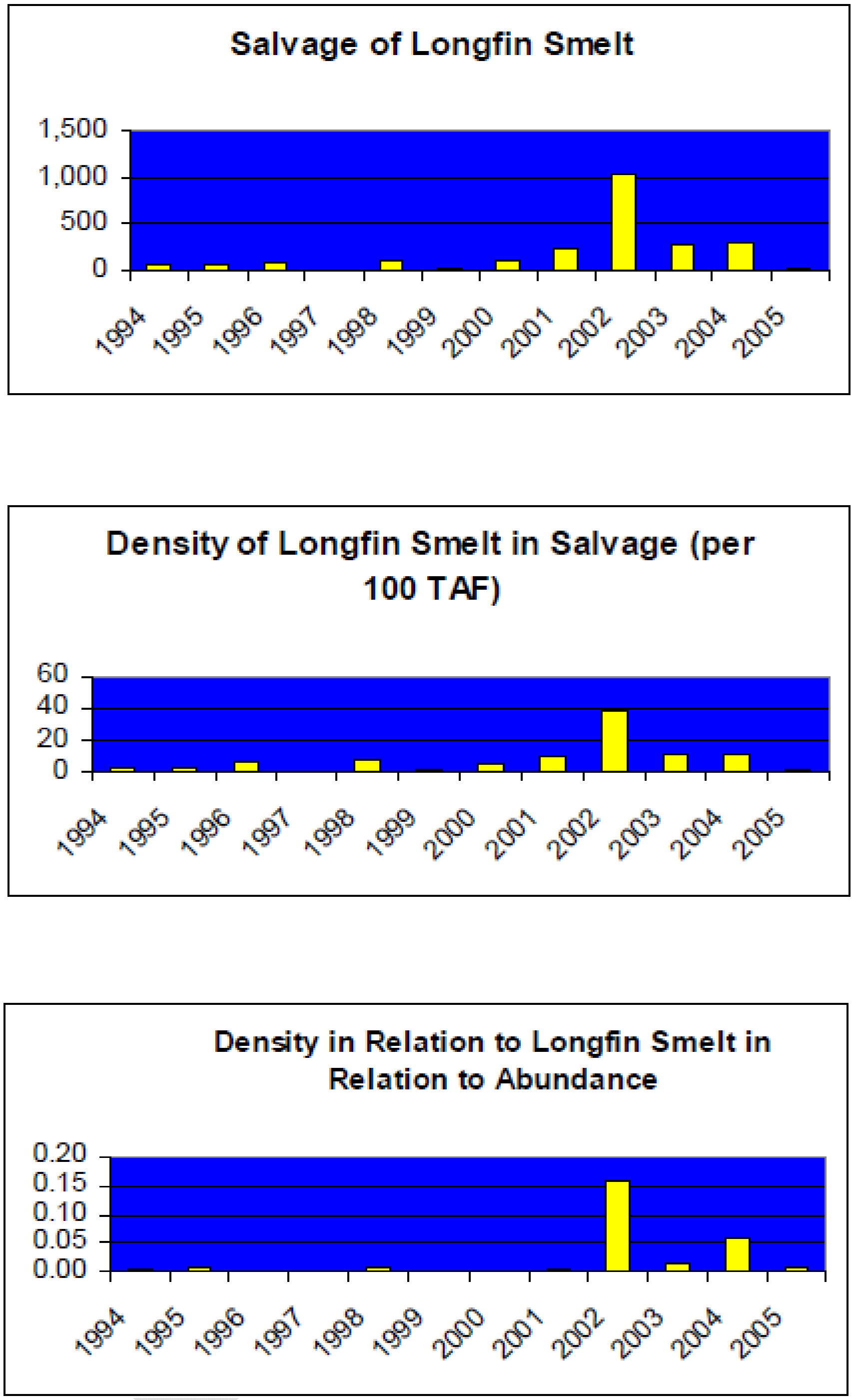


Figure 5-3. Total November through March Salvage of Longfin Smelt, Salvage Density and Salvage in Relation to Preceding Fall Midwater Trawl Abundance.
Source: Herbold et al. 2005

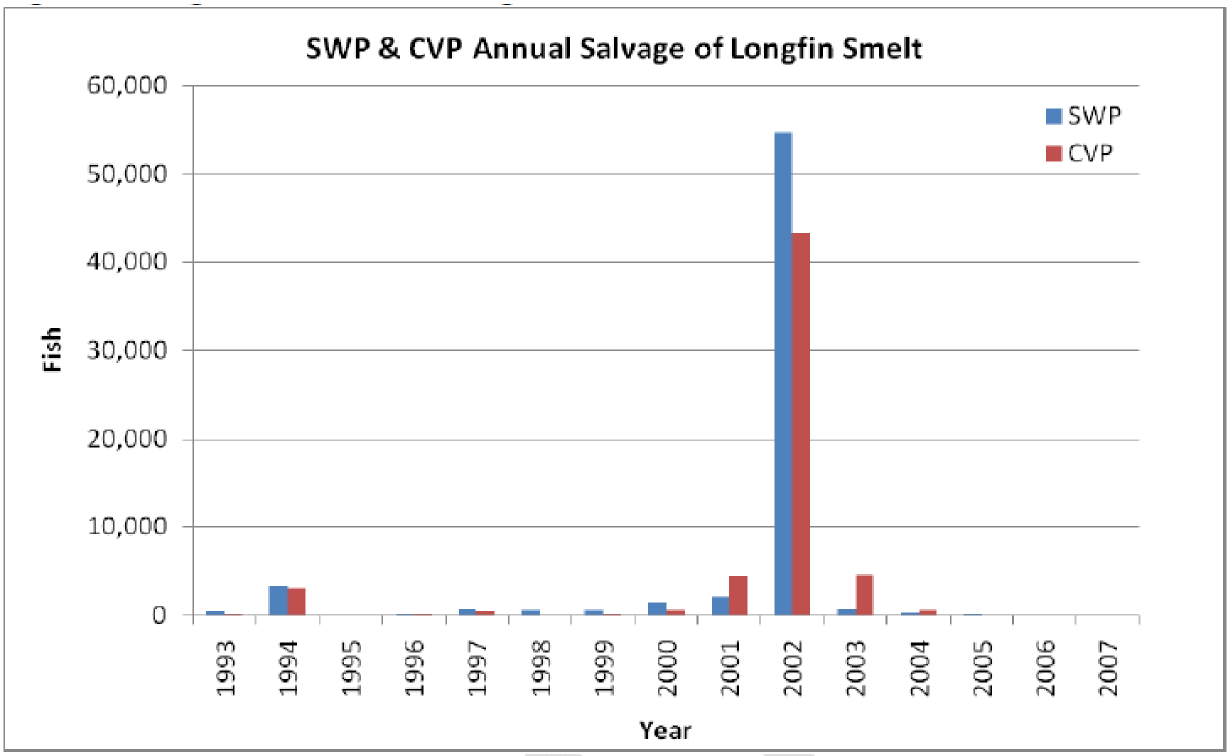


Figure 5-4. Longfin Smelt Annual Salvage at SWP and CVP Facilities
Source: SWC 2008

Table 5-3. Longfin Smelt Annual Salvage for the SWP and CVP

Year	SWP	CVP
1993	516	132
1994	3400	3015
1995	102	0
1996	137	156
1997	742	444
1998	628	60
1999	673	132
2000	1455	528
2001	2175	4404
2002	54582	43188
2003	706	4562
2004	333	648
2005	183	36
2006	0	0
2007	60	36

Source: SWC 2008

Salvage of longfin smelt by the SWP and CVP operations is further illustrated by information presented by DFG (Baxter 2008a, *as cited in* SWC 2008) (**Figure 5-5**). Figure 5 shows 15-year cumulative monthly salvage estimates. The 15-year cumulative monthly salvages of Age-1 and Age-2 longfin smelt total 1,133 longfin smelt (Baxter 2008b, *as cited in* SWC 2008). This equates to an average of 76 fish per year and 6 fish per month, and a median of 1 fish per month over 1993 to 2007 (SWC 2008). Cumulative salvage was greatest in January at 833 Age-1 and Age-2 longfin smelt, which averages out to 56 fish salvaged per year for the month of January. If subadults (Age-0) are included, the annual average January salvage is 67 longfin smelt. Annual Age-1 and Age-2 salvage rates for the remaining months average 2 longfin smelt per year (SWC 2008).

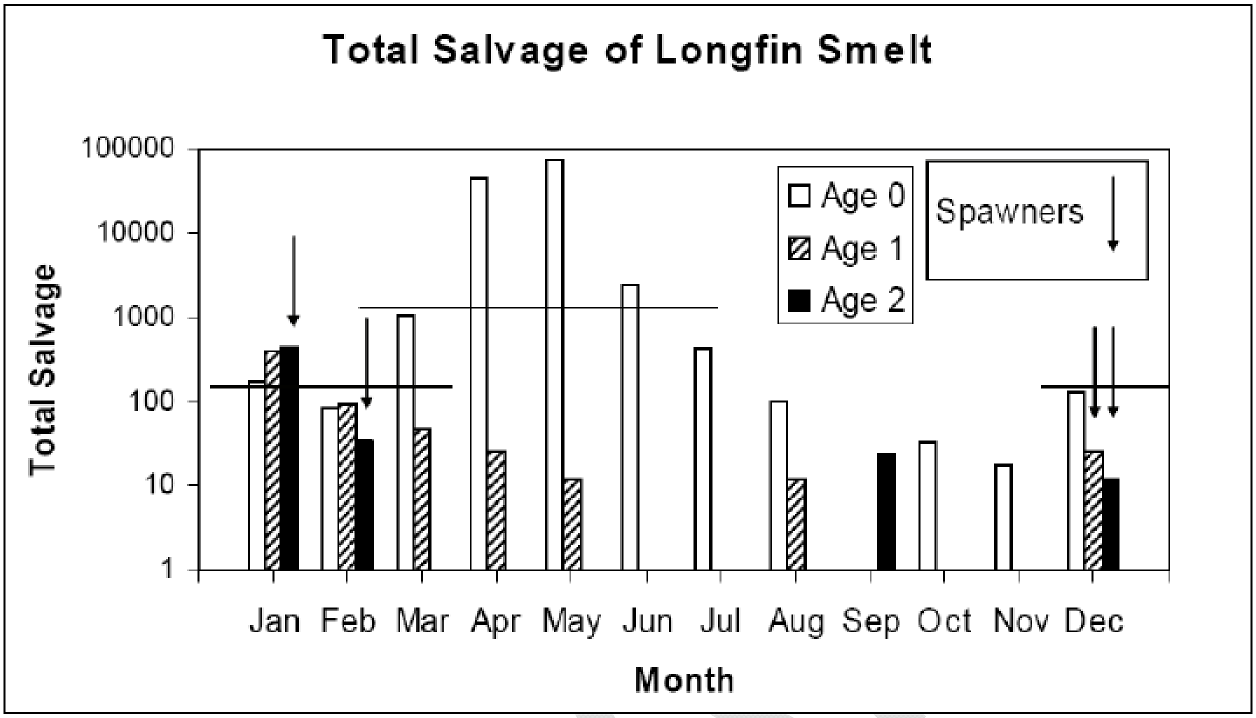


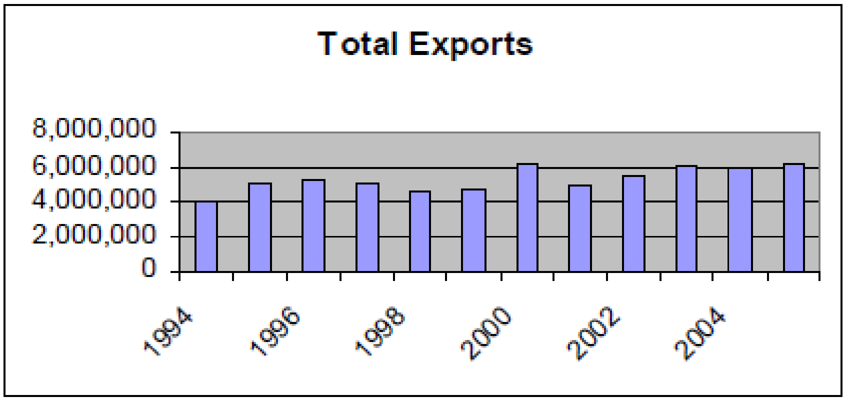
Figure 5-5. Salvage During 1993 through 2007 Total by Month
Source: Baxter 2008a, *as presented in* SWC 2008

5.2 Relationship Between Longfin Smelt Salvage and Habitat Parameters

Concern for risk of entrainment increases the farther X2 is located above river kilometer 70 during winter and sprint and abates during periods of high outflow. The highest and most consistent salvage of adult longfin smelt occurs when X2 is above 60 rKm. Sacramento River flow of 80,000 cfs or greater pushes X2 well below rKm 60 (DFG 2008b), moving water conditions suitable for longfin smelt spawning downstream of the Delta and transporting larvae downstream away from the Delta as well (Baxter 1999, Dege and Brown 2004).

Herbold et al. (2005) identify and discuss several potential reasons for increases in salvage, including increased efficiency at the salvage facilities, decreased pre-screen loses, increased susceptibility to entrainment due to poor health, reduction in suitability of other areas of the Delta resulting in a concentration of fish in the south Delta, changes in flows, barrier operations and export operations, and increases in volume of exports.

The sharp increase in the volume of total winter-time exports (**Figure 5-6**) has occurred during the winter when salvage has increased (Figure 5-6). However, the increase in density at salvage, which was shown by all species examined, indicates that the salvage increase is not explainable as a simple increase in volume of exports (Herbold et al. 2005).



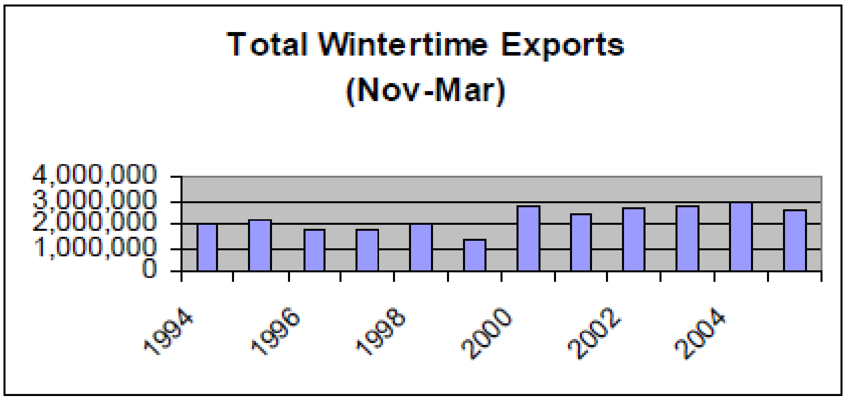


Figure 5-6. Total Annual and Total Wintertime Exports, both Projects (CVP and SWP) combined.
Source: Herbold et al. 2005

Herbold et al. (2005) graphed the results of DSM-2 particle tracking modeling (Kimmerer and Nobriga unpublished data, *as cited in* Herbold et al. (2005) to evaluate the theoretical nature of the relationship between the volume of exports in relation to inflow (the E/I ratio) and particle entrainment. In each of the simulations shown in **Figure 5-7**, the modeled particle insertion location (Bacon Island or Twitchell Island) started with 5,000 particles. Thus, each model run had an equivalent particle 'density'. The fraction of particles subsequently entrained into the export facilities is presented. The results show that for a site close to the export facilities (Bacon Island), virtually all particles are taken in at all E/I ratios greater than 20%. Thus, the model results suggest that the facilities provide a more accurate estimate of Bacon Island particle density at E/I ratios greater than 20%. For a more distant site (the mainstem San Joaquin River at Twitchell Island) the density estimate improves linearly as a function of E/I ratio (Herbold et al. 2005).

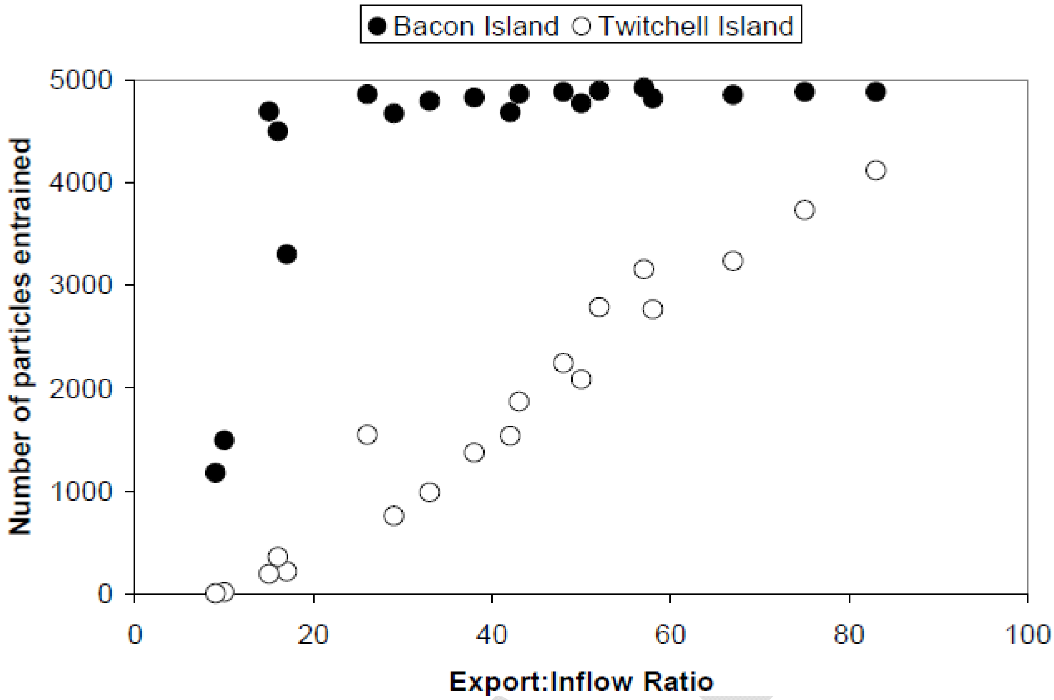


Figure 5-7. Relationship of E/I Ratio to Number of Particles Entrained over a Series of Particle Tracking Model Runs
Source: Herbold et al. 2005

Herbold et al. (2005) examined the actual E/I ratios in recent winters; the average November-March E/I ratio for 1994-2000 was 24% whereas the average for 2001 to 2005 was 36% (**Table 5-4**). The most striking difference from water year 1995-2005 was the general lack of very low (< 20%) E/I ratios for the 2001-2005 period (**Figure 5-8**). These results suggest that recent-year changes in exports in relation to inflow would change the fate of modeled particles and by extension, probably increase both fish salvage and fish salvage densities at the facilities. Virtually all particles close to the export facilities would be entrained, while almost twice as many particles could be entrained from more remote sites (e.g., Twitchell Island). Combined with decreases in San Joaquin flow peaks and increased use of agricultural barriers, these results suggest Delta hydrodynamics may have been substantially altered during the last 5 years. Although these results provide a likely hydrodynamic mechanism for the recent increases in wintertime fish salvage, a much more intensive empirical modeling effort is appropriate. Winter salvage levels subsequently decreased to very low levels for all POD species during the winters of 2005-2006 and 2006-2007, possibly due to the very low numbers of fish that appear to remain in the estuary (Reclamation 2008).

Table 5-4. E/I Ratios for each Month of Recent Years

Water Year	Nov	Dec	Jan	Feb	March	Seasonal Average
1994	47	48	35	27	26	37
1995	54	45	20	12	4	27
1996	35	18	32	6	5	19
1997	53	14	1	2	19	18
1998	53	43	19	1	2	24
1999	21	4	12	6	9	10
2000	57	34	43	15	11	32
2001	62	53	36	36	29	43
2002	49	32	29	42	33	37
2003	20	29	17	27	41	33
2004	56	29	31	23	21	32
2005	60	48	33	30	19	38

Source: Herbold et al. 2005

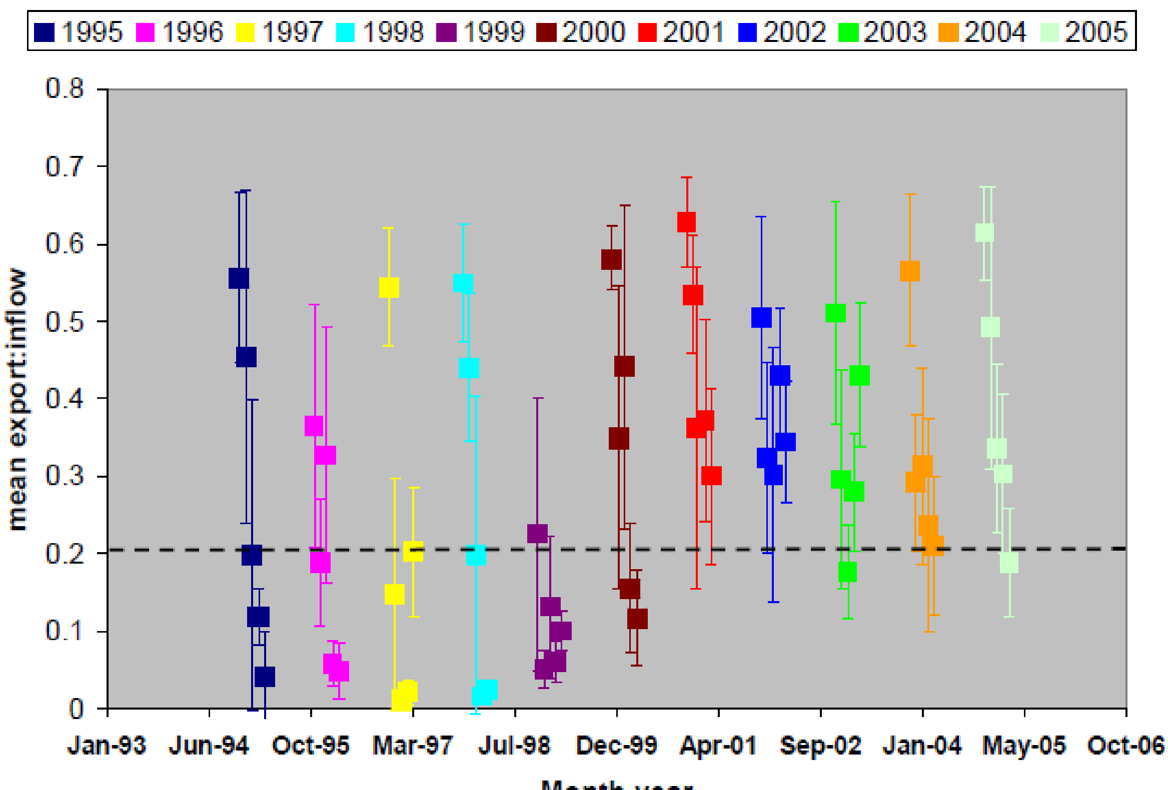


Figure 5-8. Monthly Average E/I Ratios ± 1 SD for November through March of Water Years 1995 through 2005. Notes: 2005 dates are draft.
Source: Herbold et al. 2005

Recent analyses by scientists from the USGS and CDWR have suggested a mechanism for the recent disproportionately high take of longfin smelt (and other fish species) at the SWP and CVP facilities (Simi and Ruhl 2005; Ruhl et al. 2006; Sommer 2007, *as cited in* The Bay Institute et al. 2007). Using data from the past twenty years, these researchers reported a significant correlation between high incidental take of small pelagic fishes like longfin smelt and negative flows in central and southern Delta channels caused by low San Joaquin River inflows and high water export rates (see **Figure 5-9**). Under these conditions, normal tidal exchange and flows were disrupted (with the ebb tidal flow nearly eliminated); flows in two important Delta channels, Old River and Middle River, were negative; virtually all water (i.e., habitat for the pelagic longfin smelt) in the central and southern regions of the Delta was drawn inexorably to the pumps; and incidental take of longfin smelt (and other pelagic fishes) was high (The Bay Institute et al. 2007). During the past twenty years, the frequency of occurrence of these types of conditions has increased.

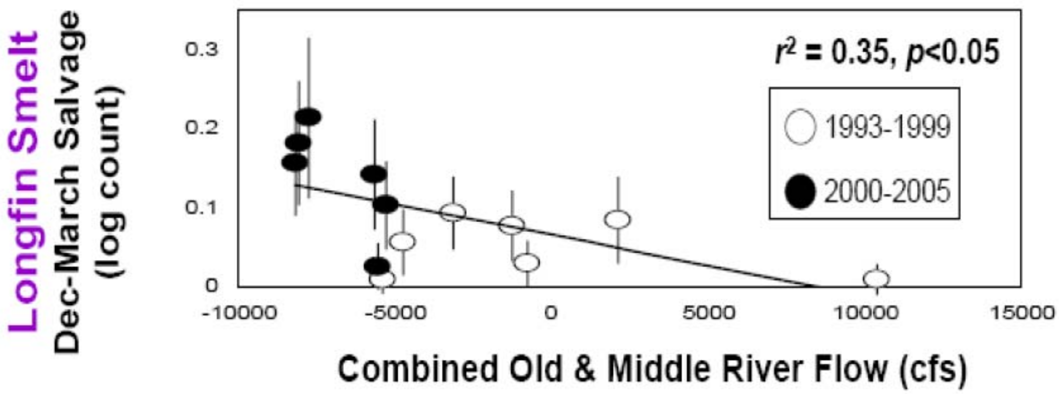


Figure 5-9. Relationship between Incidental Take ("salvage, as the log of the number of fish counted) and Combined Flows in Old and Middle River Channels in the Southern Delta. *Note: Negative flow values indicate net flow is upstream towards the SWP and CVP Delta water export pumps; positive flows indicate net flow downstream toward Suisun Bay*
Source: Sommer 2007, *as presented in* The Bay Institute et al. 2007

5.3 Effects of Salvage on the Longfin Smelt Population

Incidental take of longfin smelt at diversions (other than the SWP and CVP export facilities) and of larval and juvenile fish <20 mm in length at the government water project facilities is neither monitored nor reported and no effort is made to rescue these fish (The Bay Institute et al. 2007). Therefore, the incomplete data on incidental take are of limited value for evaluating the effects of water export activities on longfin smelt population levels, although they do provide useful information on the timing and presence of the fish in the south and central Delta (The Bay Institute et al. 2007).

Analyses conducted by Herbold et al. (2005) as part of the ongoing multi-agency research program to investigate the recent pelagic fish declines in the Delta indicated that the direct impacts of water exports on longfin smelt (and other Delta pelagic fish species) during the winter had increased in recent years, coincident with substantial population declines measured for all the affected species. Beginning in 2000, incidental take (i.e. "salvage") of adult longfin smelt increased markedly, concurrent with substantial increases in exports and declines in longfin smelt abundance. In 2002, direct loss of adult longfin smelt at the pumps in relation to the species' population abundance reached its highest level in more than ten years (The Bay Institute et al. 2007).

Lethal entrainment of juvenile longfin smelt at the SWP and CVP facilities has also reached record high levels during recent years. In the spring of 2002 (April-May), more than 95,000 juvenile longfin smelt were killed at the pumps, more than ten times higher than the highest total annual take level measured during any year during the previous decade (The Bay Institute et al. 2007).

The State Water Contractors (SWC 2008) analyzed salvage and entrainment risks for longfin smelt subadults and spawners salvaged in the late fall and winter, and larvae and juvenile longfin smelt salvaged January through June. Their methods, results and conclusions are summarized below.

SWC (2008) analyzed DFG's survey data from the FMWT, Winter Midwater Trawl and Spring Kodiak Trawl (SKT), and grouped the sampling stations to represent five-major geographic regions; the Napa-River-Carquinez Strait (NapaCarq), Suisun Bay and Marsh (Suisun), north Delta, south Delta, and southeast Delta (**Figure 5-10**). Six of the FMWT and WMWT stations are in the southeast Delta, while only stations 914 and 915 are sampled by the SKT (**Figure 5-11**). Based on DFG's survey data, from 1993 to 2007, there is no evidence of longfin smelt being caught in the FMWT, WMWT or SKT samplings at southeast Delta stations (SWC 2008).

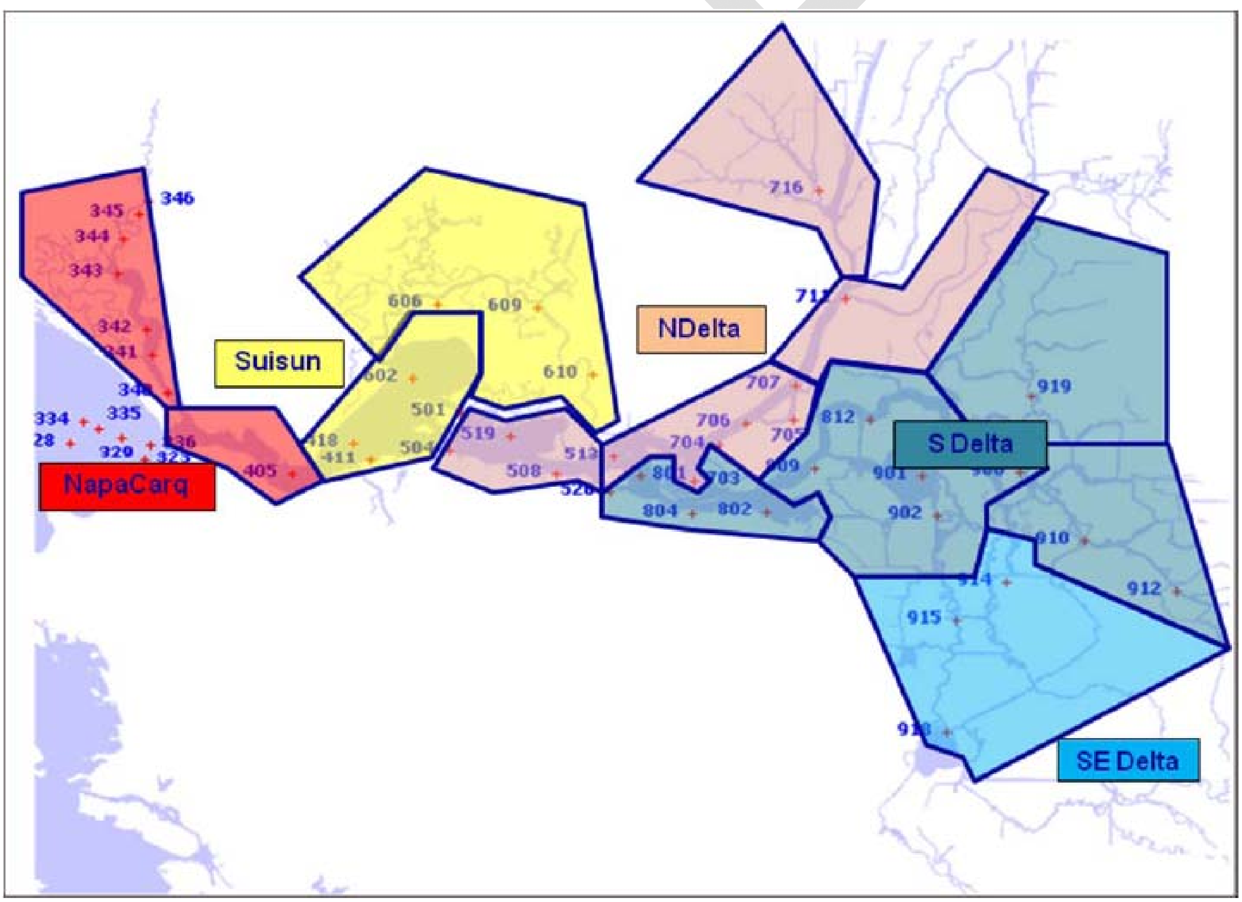


Figure 5-10. Five Regions for Allocating Sampling Stations of the FMWT, SKT, and 20mm Survey Source: SWC 2008

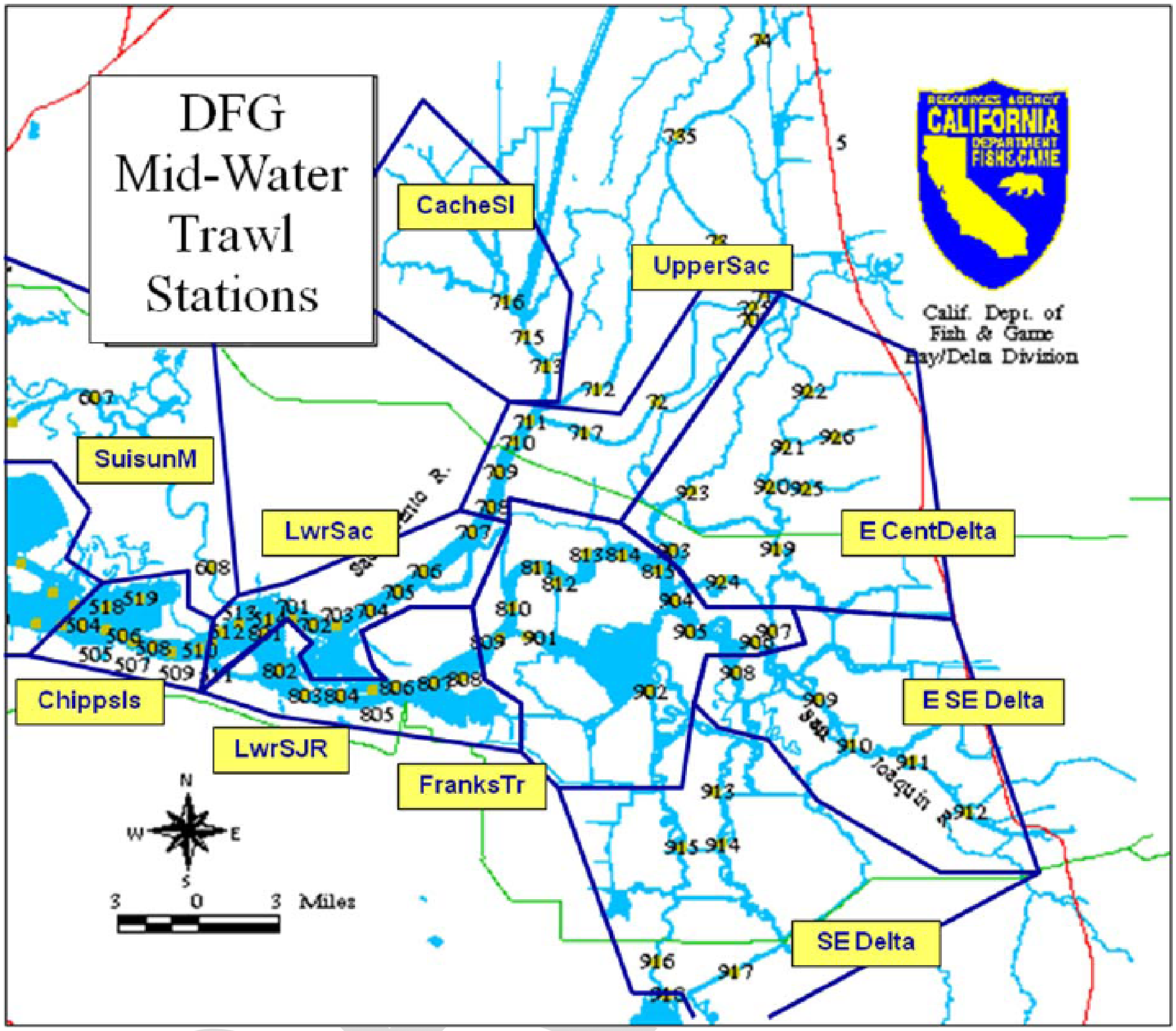


Figure 5-11. Fall and Winter Midwater Trawl Survey Stations and the Southeast Delta Region Source; SWC 2008

SWC (2008) used the catch and volume of the tow data to estimate average densities within each region. Then, these average densities were multiplied by the region volume to yield regional abundance values. Summing regional abundances provided an estimate of overall abundance index. By dividing the Southeast Region abundance index by the overall abundance value, an indication of the risk of entrainment was obtained. Details on the data and the calculations are provided in SWC (2008). SWC (2008) note that they are not claiming that any of the abundance indices are accurate estimates or that any of the differences among indices are statistically significant. Additionally, comparisons of abundance indices among regions or over a survey program can be more reliable when considered on a relative basis, that is, relative to each other, removing the issue of accuracy in absolute abundance estimates.

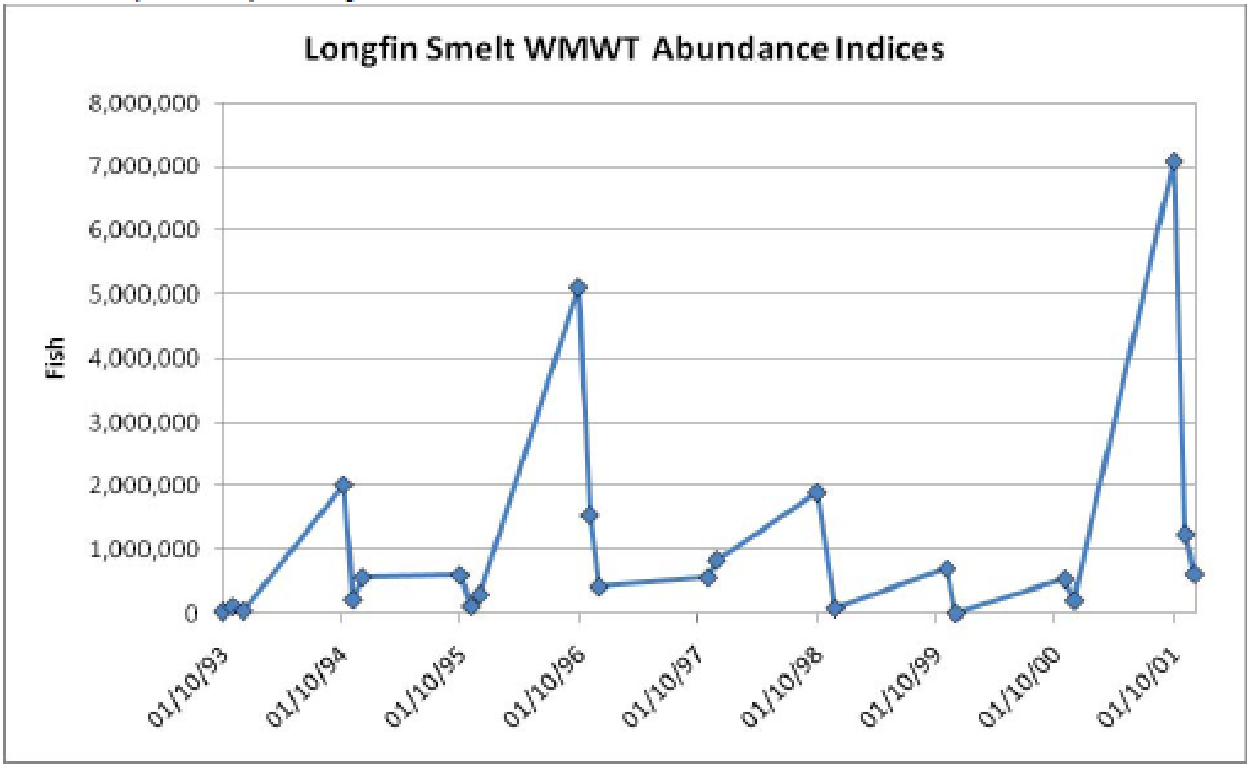
Overall longfin smelt abundance indices vary within and between years as well as between sampling programs (**Figure 5-12**) (SWC 2008). The WMWT indices averaged 940,398 fish, had a median of 456,858, and ranged from 0 to 7.1 million longfin. The SKT indices averaged 161,039 fish, had a median of 57,485, and ranged from 0 to 1.3 million. Most of these winter longfin smelt were far from the pumps. While zero longfin smelt are estimated for the southeast Delta region, up to 4 million was estimated for the Napa-Carquinez region for January 2001 (**Figure 5-13**). Few were ever in the South Delta region. For the winter of 2002, up to 0.4M was estimated, and for the Suisun region. Again, the South Delta region had few while the Southeast Delta region had no longfin smelt (SWC 2008).

During January, the highest spawner salvage month (see Figure 5, above), subadult and spawner salvage over 1993-2007 averaged 67 longfin smelt, as mentioned above. January abundance indices for longfin could be made for all but four years over 1993-2007 (**Table 5-5**). The average for the 11 years with data is 1.6 million, for which an average January salvage of 67 longfin amounts to 0.004%. Switching from a 15-year perspective to just the January 2002 (and late December 2001), salvage totaled 177 longfin smelt, which amounts to 0.03% of the concurrent SKT abundance index of the 626,459 longfin (**Figure 5-14**). SWC (2008) concludes that these percentages indicate that controlling salvage will do little to influence winter abundance of longfin smelt.

Table 5-5. January Abundance Indices for Longfin Smelt

January	Longfin Smelt Indices of Abundance From WMWT or SKIt
1993	35,525
1994	2,019,298
1995	605,417
1996	5,115,441
1997	No Survey
1998	1,895,058
1999	No Survey
2000	No Survey
2001	7,095,904
2002	626,459
2003	No Survey
2004	314,409
2005	11,724
2006	10,752
2007	369,043

Source: SWC 2008



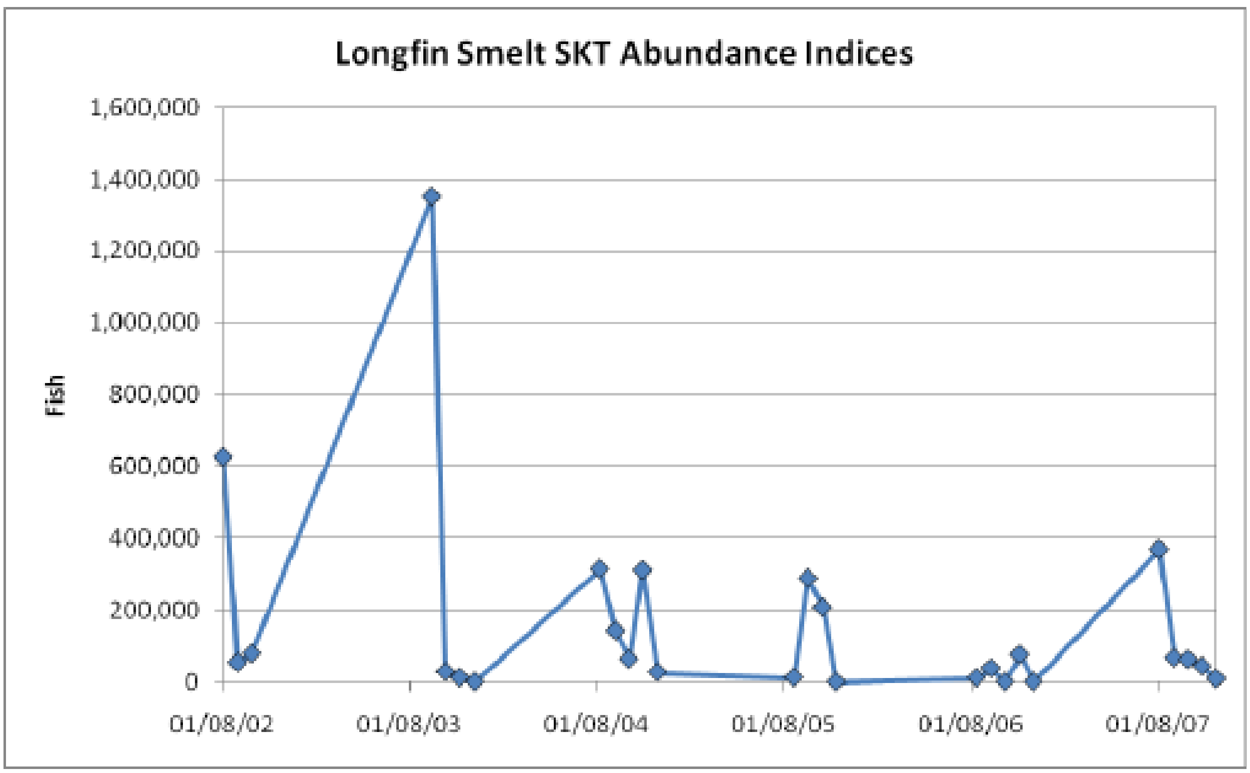
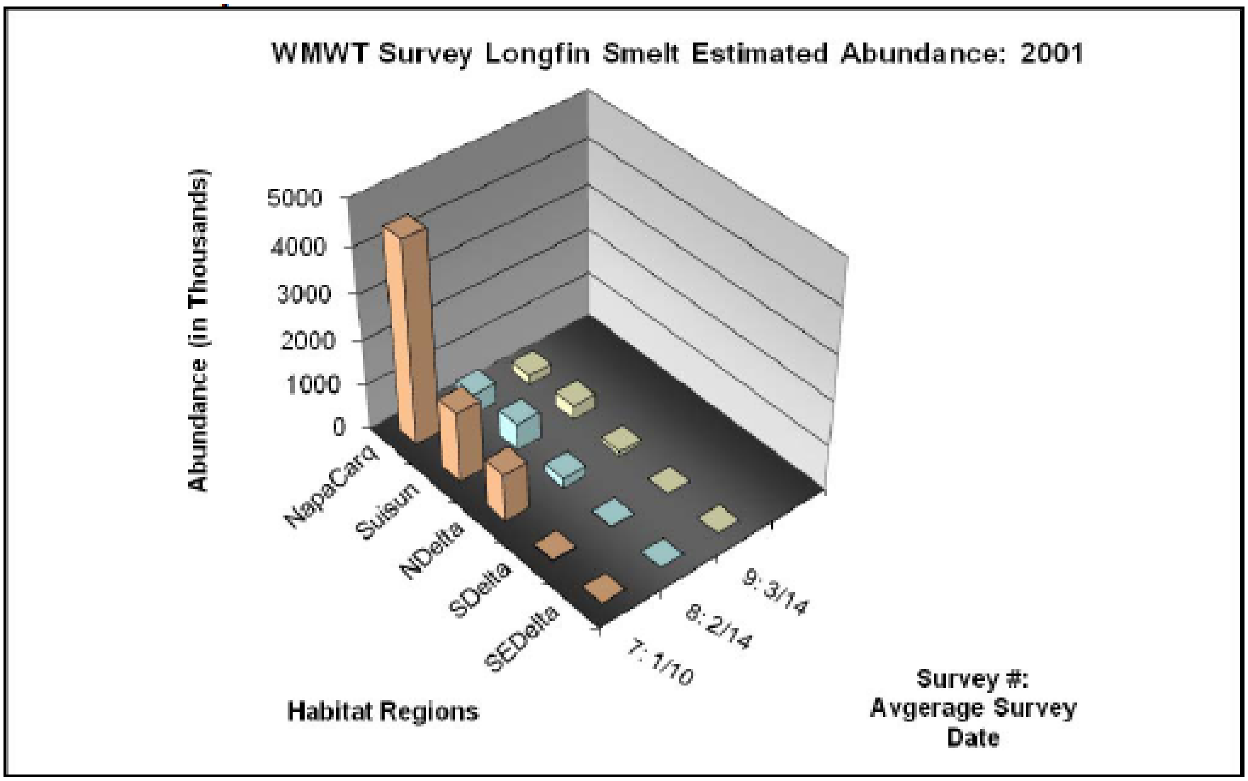


Figure 5-12. Longfin Smelt Abundance Indices based on Data from WMWT (1993 – 2001) and SKIT (2002 – 2007) Surveys
Source: SWC 2008



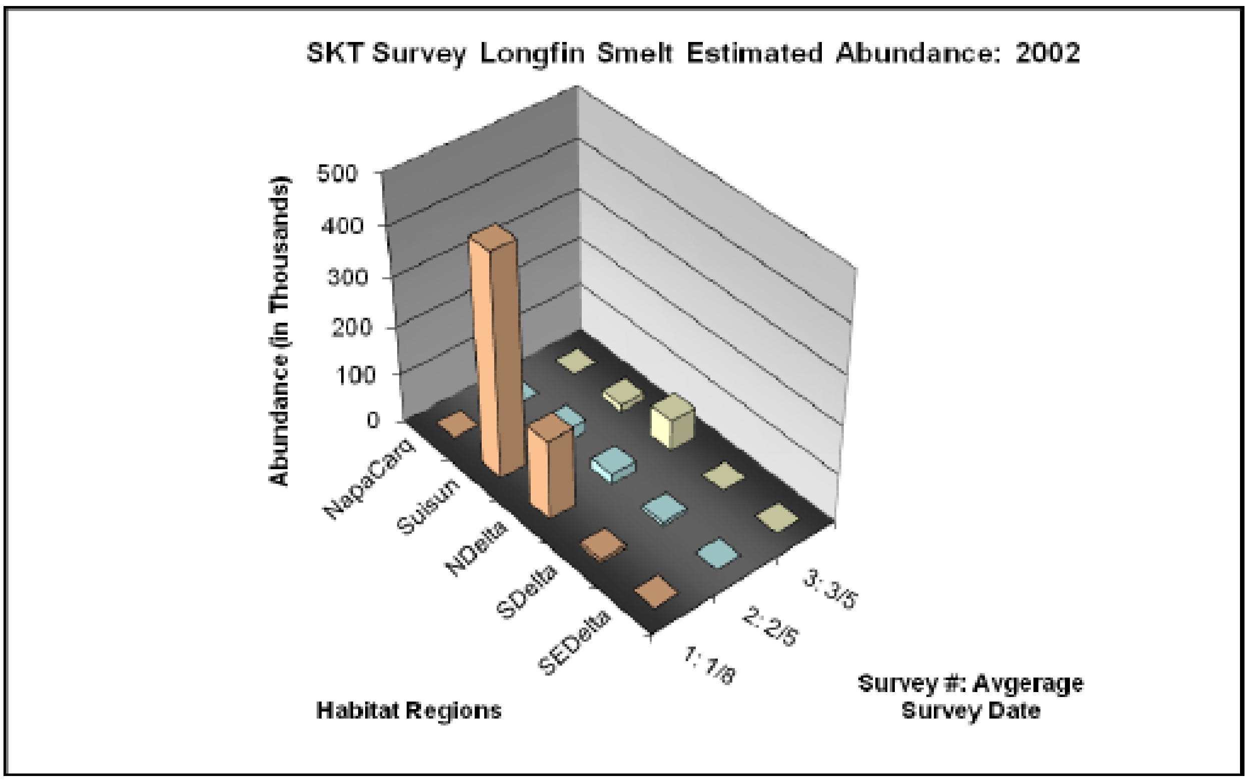


Figure 5-13. Regional Abundance Indices for Longfin Smelt during the 2001 WMWT and the 2002 SKT Surveys
Source: SWC 2008

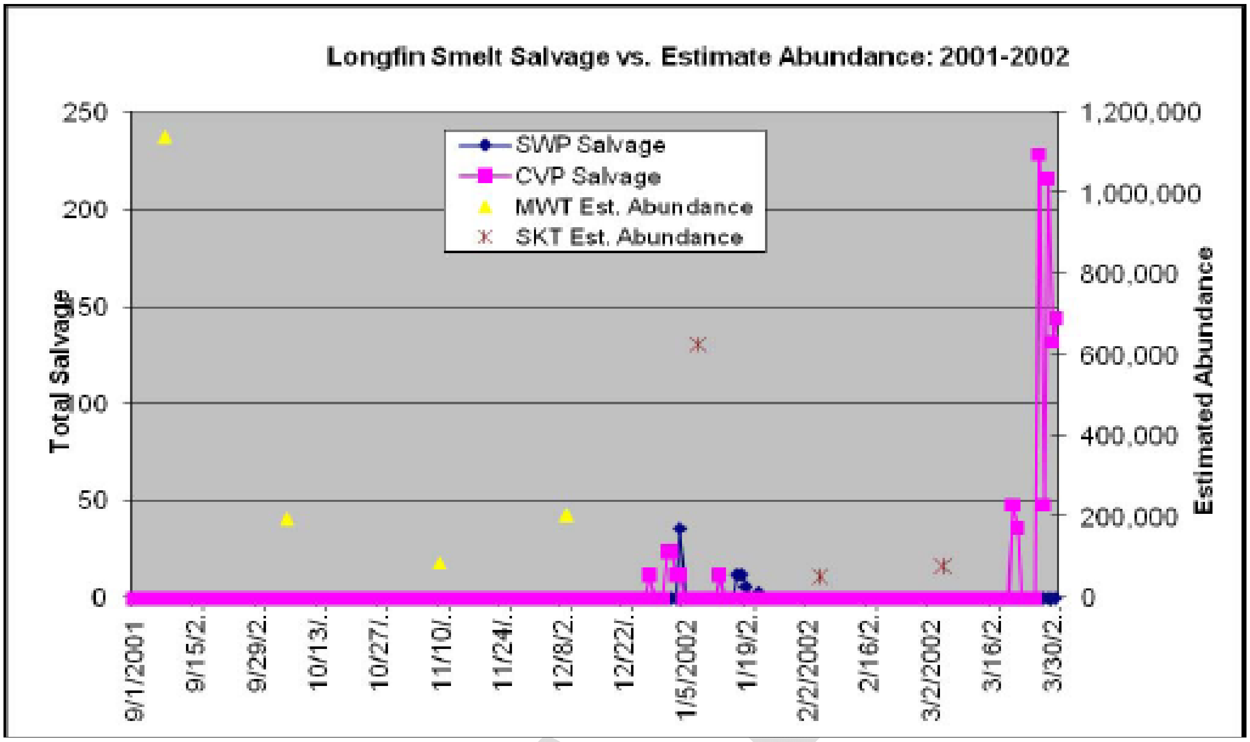
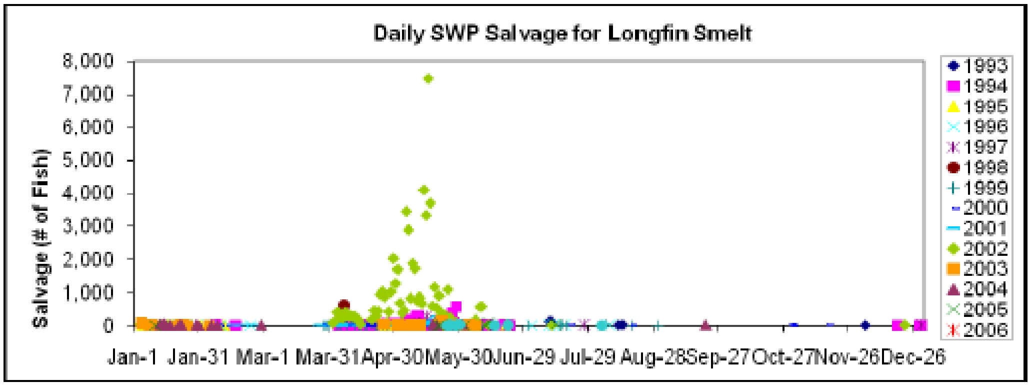


Figure 5-14. Longfin Smelt Daily Salvage and WMWT or SKT Abundance Indices for the Average Survey Dates during Fall and Winter 2001 and 2002. *Note: Salvage in December and January was of subadults and adults, except for possibly 3 juveniles in December, while CVP salvage in March was ≥ 95% larvae and juveniles and up to 5% subadults.*
Source: SWC 2008

Although larvae are abundant in the Bay/Delta during January-April (Baxter 2008a, *as cited in* SWC 2008), salvage operations do not detect longfin smelt until March, when fish reach 20mm or more in length **(Figures 5-15 and 5-16**) (SWC 2008). SWC (2008) notes that larvae (<20mm) are likely to be entrained although the numbers are unknown.

Larval/juvenile longfin smelt abundance indices for the Southeast region relative to all other regions can be useful in gauging entrainment risk and potential population effects. Although the 20 mm surveys data are conducted March-June, two to three months after longfin start hatching, it is the only source of data available for evaluating the distribution and abundance of these life stages (SWC 2008). Using the methodology described SWC (2008) for the WMWT- and SKT-based adult abundance indices, the 20 mm survey catch data was expanded to provide total as well as regional larvae and juvenile abundance estimates (SWC 2008).



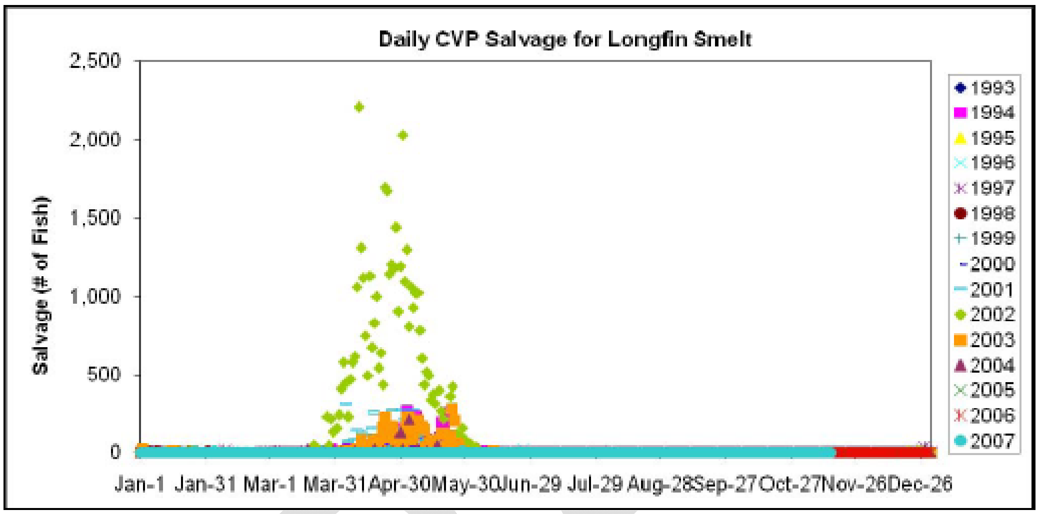


Figure 5-15. SWP and CVP Longfin Smelt Daily Salvage. Note: Most of the salvaged fish are juveniles.
Source: SWC 2008

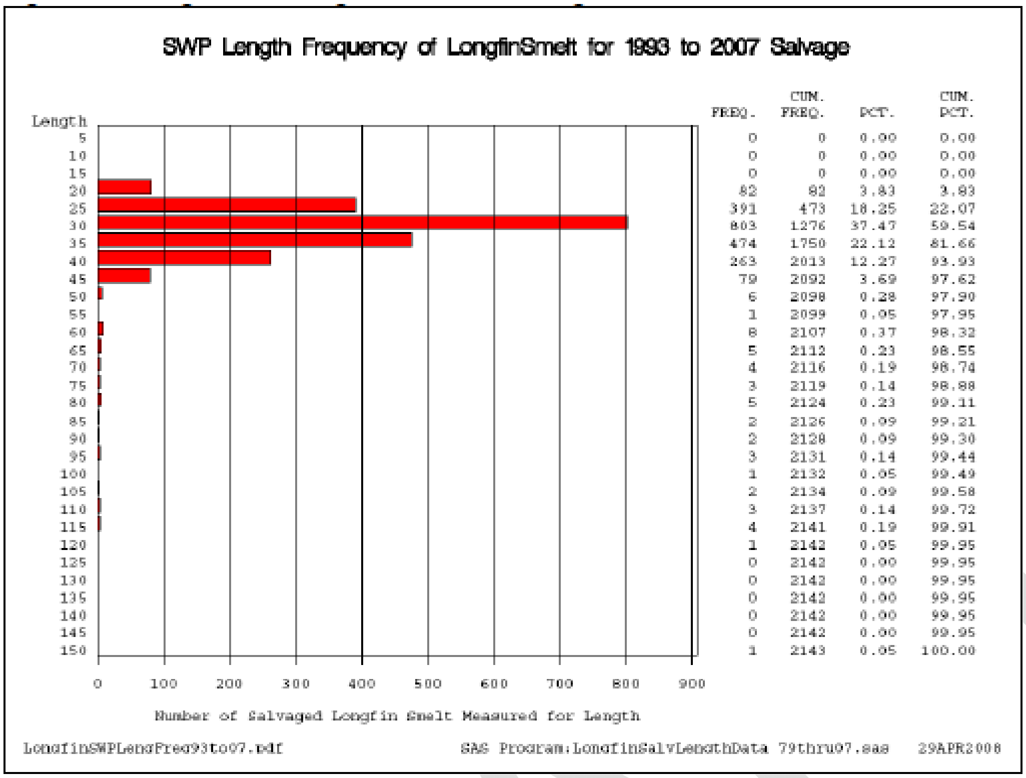
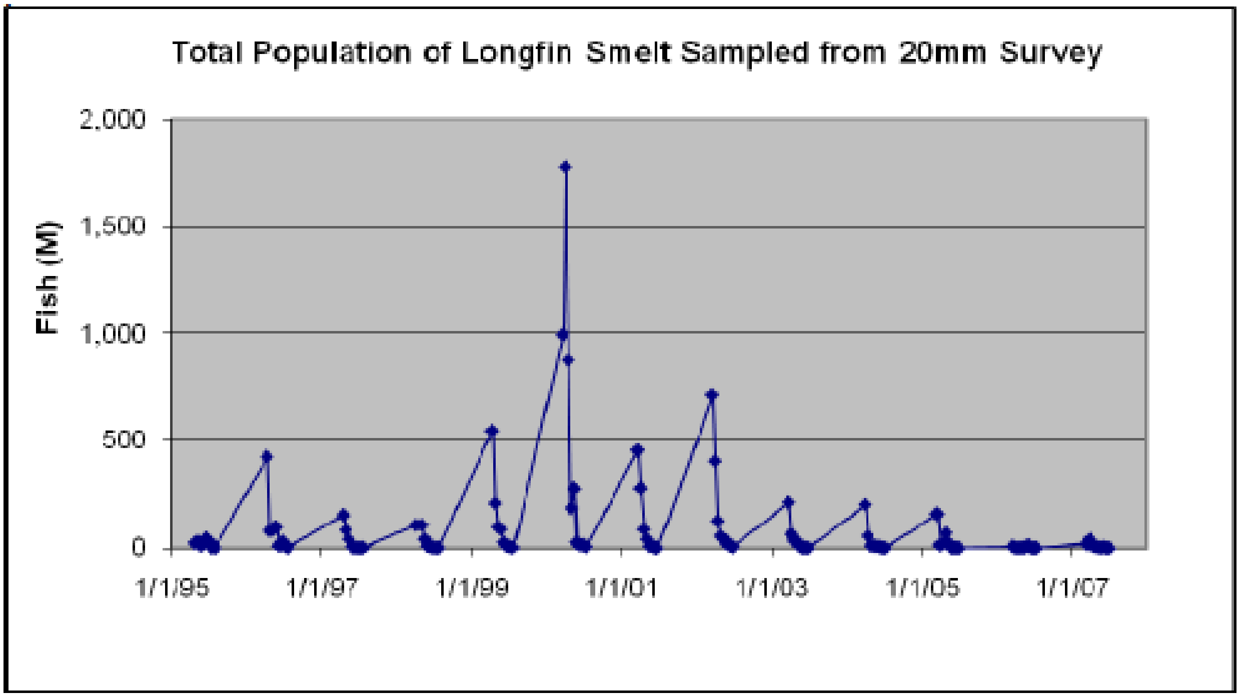


Figure 5-16. Longfin Smelt Lengths from SWP Salvage
Source: SWC 2008

A small portion of the larval and juvenile longfin smelt population has resided in the southeast region of the Delta (SWC 2008). Overall larval and juvenile longfin smelt abundance indices range from the hundreds of thousands to over 1.5 billion, with most years in the 10’s of millions range. (**Figure 5-17**). The fraction of the overall longfin smelt abundance indices accounted for by longfin smelt in the southeast Delta range from 0 to 2%, with most values at 0% (Figure 15) (SWC 2008). Instead of being in the Southeast Delta, most longfin appear to have been seaward. In 2002, the highest salvage year, and the two preceding years, for example, most longfin smelt were in the North Delta, Suisun, and Napa-Carquinez areas (**Figure 5-18**) (SWC 2008).

The SWC (2008) stated that almost all longfin smelt are far from the pumps, whether spawners, larvae or juveniles, over the period they analyzed (1993 – 2007). In terms of abundance, SWC (2008) indicated that the fraction of longfin smelt near the pumps is so small that it appears to have little capacity to affect overall abundance. SWC (2008) identifies other factors potentially affecting the longfin smelt population, including temperature, ammonia, and X2. For further information on their analyses and preliminary findings, see SWC (2008).



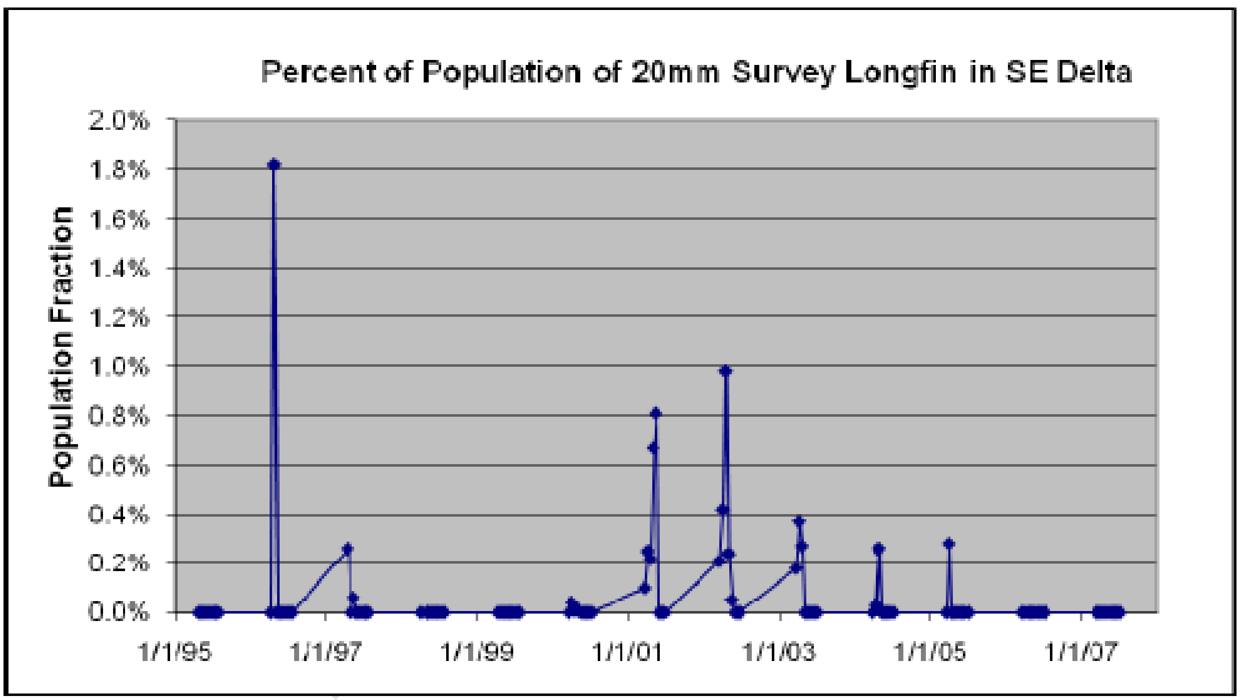
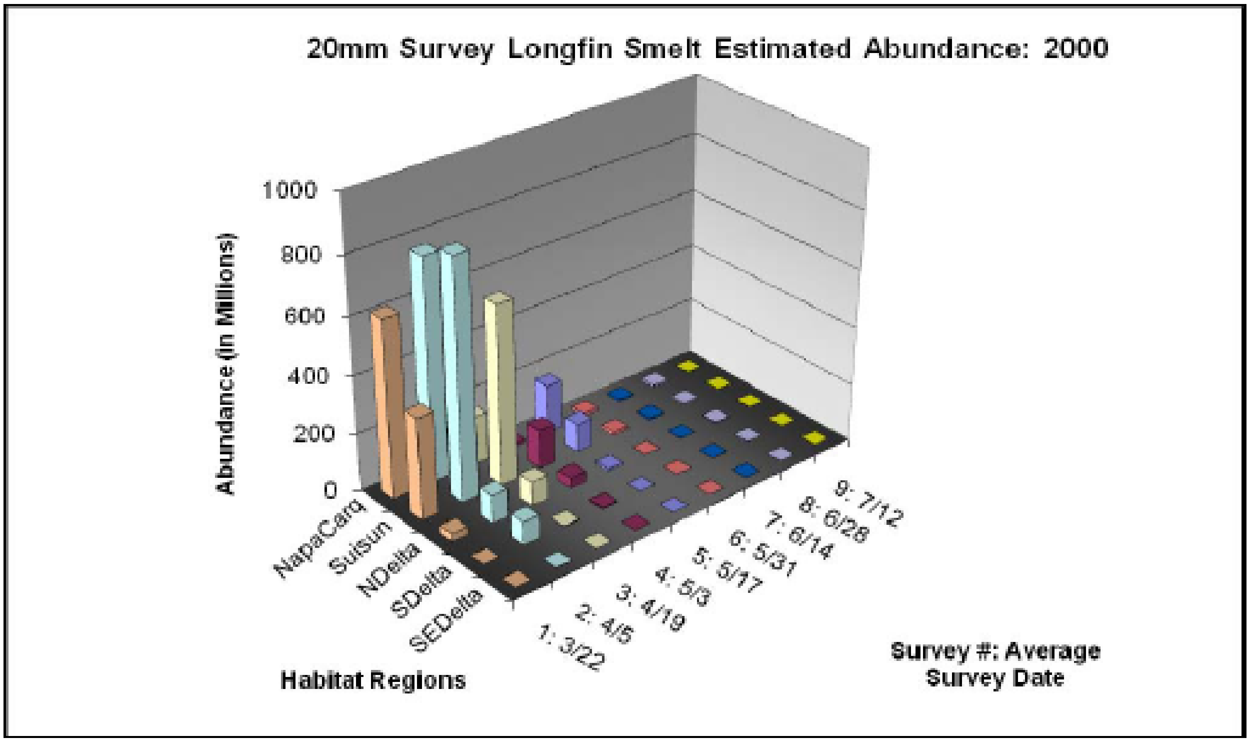
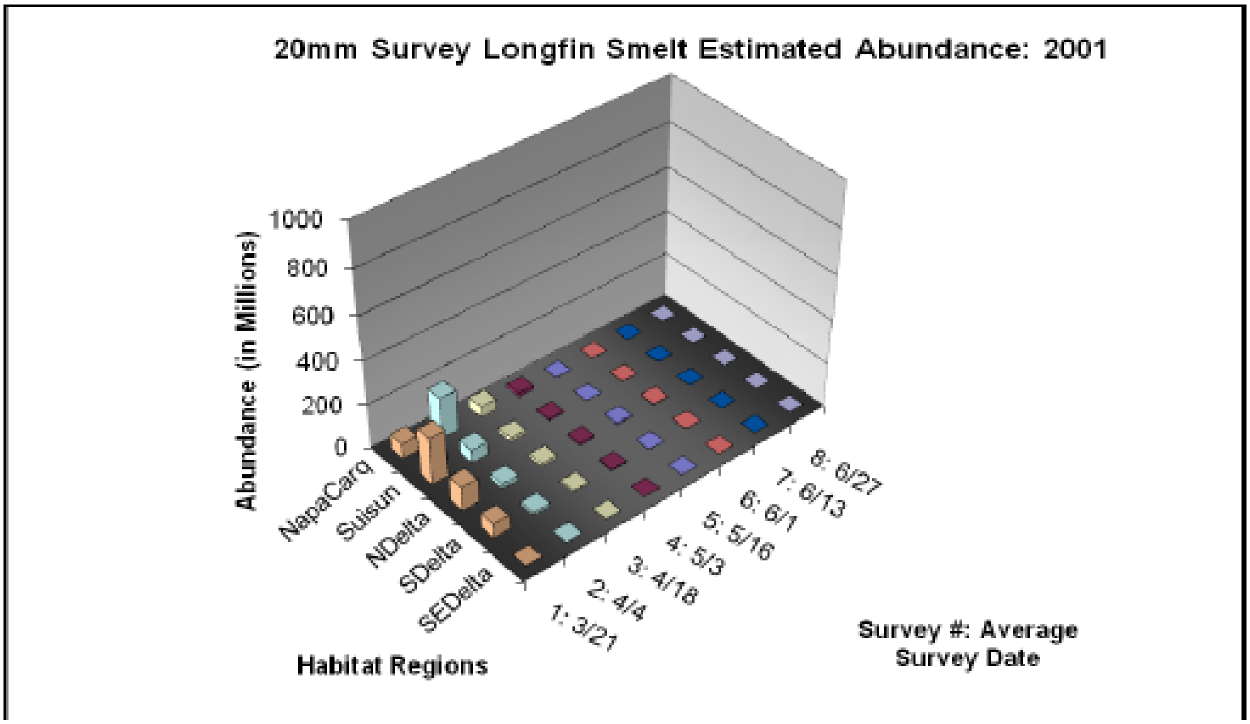


Figure 5-17. Longfin Smelt Larval and Juvenile Abundance Indices Over All Regions and the Percentage in the Southeast Delta
Source: SWC 2008


20mm Survey Longfin Smelt Estimated Abundance: 2000
Abundance (in Millions)
1000
800
600
400
200
0
NapaCarq
Suisun
NDelta
SDelta
SEDelta
Habitat Regions
1: 3/22
2: 4/5
3: 4/19
4: 5/3
5: 5/17
6: 5/31
7: 6/14
8: 6/28
9: 7/12
Survey #: Average Survey Date


20mm Survey Longfin Smelt Estimated Abundance: 2001
Abundance (in Millions)
1000
800
600
400
200
0
NapaCarq
Suisun
NDelta
SDelta
SEDelta
Habitat Regions
1: 3/21
2: 4/4
3: 4/18
4: 5/3
5: 5/16
6: 6/1
7: 6/13
8: 6/27
Survey #: Average Survey Date

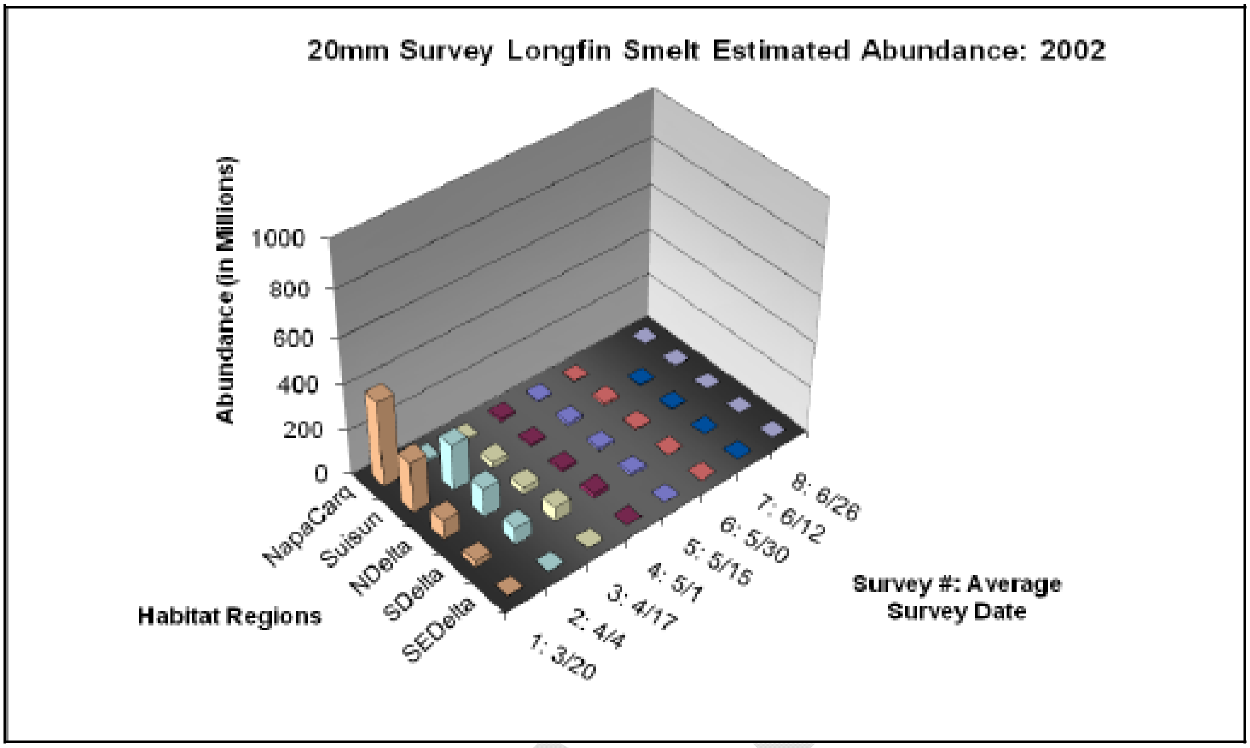


Figure 18. Larval and Juvenile Longfin Smelt Abundance Indices Across Regions for 2000, 2001 and 2002
Source: SWC 2008

6.0 OCAP Biological Opinion (RPA Components)

6.1 Implications of implementing the Fish and Wildlife Service OCAP Biological Opinion (RPA Operational Components) on Longfin Smelt

The USFWS biological opinion on the effects of the Coordinated Operation of the Central Valley and State Water Project to the threatened delta smelt identifies five reasonable and prudent action (RPA) components that address project related constraints to the recovery of delta smelt. These actions were developed based on the relationships between delta smelt entrainment and habitat conditions and various indicators of the influence of the projects on the hydrodynamics within the Bay-Delta. Although delta smelt and longfin smelt habitat requirements and life histories differ in many significant ways, the description of the influences of the projects on these two species is defined using these same indicators. As such, the conditions resulting from implementation of the RPAs described in terms of the hydrodynamic indicators can be assessed to determine relative and directional change in effects on longfin smelt.

Similarly, the information presented above identifies two general effects of the project on longfin smelt, entrainment and habitat modification. Both effects are discussed in terms of hydrodynamic conditions in relation to life stage vulnerability, as do the delta smelt RPA components (1 through 3). The following is an assessment project effect on longfin smelt, including the level of take and the effect of that take based upon a conceptual linkage between the conditions potentially occurring as a result of implementation of the RPA operational actions and the response of longfin smelt based on the preceding discussion on hydrodynamic-longfin smelt relationships.

6.1.1 RPA Component 1: Protection of the Adult Delta Smelt Life Stage

The actions prescribed per RPA Component 1 are designed to reduce entrainment of pre-spawning adult delta smelt during December to March by controlling OMR flows during vulnerable periods. Action 1 is designed to protect upmigrating delta smelt. Action 2 is designed to protect adult delta smelt that have migrated upstream and are residing in the delta prior to spawning. RPA Component 1 will also increase the spawning habitat for delta smelt by decreasing the amount of Delta habitat affected by the projects prior to and during the critical spawning period.

Action 1 shall require the Projects to maintain OMR flows no more negative than -2,000 cfs (14-day running average) with a simultaneous 5-day running average flow no more negative than -2,400 cfs to protect adult delta smelt for 14 days. Action 1 shall be initiated on or after December 1^{st} until water temperature reaches 12^{o}C (based on a three station daily mean at Mossdale, Antioch and Rio Vista) or the onset of spawning is observed.

Action 2 is to provide a winter protection period between the onset of spawning (or spawning conditions) and larva emergence, Flows are to be no more negative than -5,000 cfs in the December through March period. OMR flows shall generally be in the range of -2,000 cfs to -

3,500 cfs. However, at times, the range may be between -1,250 to -2,000 cfs or -3,500 to -5,000 cfs based on conditions that are occurring within the Delta.

6.1.2 RPA Component 2: Protection of Larval and Juvenile Delta Smelt

Delta smelt larvae and juveniles are susceptible to direct mortality by entrainment. Hydrologic conditions resulting from CVP/SWP operations increase the risk of that entrainment. The objective of this RPA component is to improve flow conditions in the Central and South Delta so that larval and juvenile delta smelt can successfully rear in the Central Delta and move downstream when appropriate.

Upon completion of RPA Component 1 or when Delta water temperatures reach 12°C (based on a 3-station average of daily average water temperature at Mossdale, Antioch, and Rio Vista) or when a spent female delta smelt is detected, the projects shall operate to maintain OMR flows no more negative than -1,250 to -5000 cfs based on a 14-day running average with a simultaneous 5-day running average within 20 percent of the applicable 14-day OMR flow requirement. Depending on the extant conditions, the SWG shall make recommendations for the specific OMR flows within this range from the onset of implementing RPA Component 2 through its termination. The USFWS shall make the final determination regarding specific OMR flows. This action shall end June 30 or when the 3-day mean water temperature at Clifton Court Forebay reaches 25° C, whichever occurs earlier.

The Spring HORB shall be installed only if the USFWS determines delta smelt entrainment is not a concern.

6.1.3 RPA component 3: Improve Habitat for Delta Smelt Growth and Rearing

This component is not considered part of the project at this time. However, the objective of this component, to improve fall habitat for delta smelt through increasing Delta outflow during fall when the preceding water year was wetter than normal as defined in the SWRCB D-1641 would likely have no clear benefit to longfin smelt. The majority of longfin smelt rearing occurs downstream of the delta within deeper channel and bay and even ocean areas.

6.2 RPA Implications to Longfin Smelt

Implementation of Actions 1 and 2 could result in modest to substantial changes in export rates, which in turn would result in more positive OMR flows and potentially commensurate decrease in E/I ratio, outflow and a more westward X2. To contemplate the effects of such changes on longfin smelt, a discussion of the life history and habitat requirements pertinent to these indicators is provided followed by a specific discussion of the implication of the changes in OMR, X2, Outflow and E/I ratio on the life stages and overall population of longfin smelt.

6.2.1 Observations of Longfin Smelt Spawning

Wang (2007) provides a pertinent description of longfin smelt life history as he discusses his observations of longfin smelt life stages in context of water-year types in the Bay-Delta during the last 15 years, as discussed in the following sections.

Observations of longfin smelt spawning:

- Longfin smelt spawning behavior is elusive. Spawning requirements may involve many habitat factors.
- Similar to that of the delta smelt, longfin smelt can complete their life cycle within San Francisco Bay and Delta. Adult longfin smelt prefer higher saline water. In the fall, the adults move from San Francisco Bay and San Pablo Bay to Montezuma Slough, Suisun Bay, West Delta, and the lower reaches of the Sacramento and San Joaquin Rivers.
- Suisun Marsh is the major spawning area for longfin smelt. Some intensive spawns also occurred at the NBA and possibly in the South Delta in the early 2000s.
- Large numbers of juvenile longfin smelt were observed in the Napa River in recent years (DFG 20 mm fish sampling, 1995–2005; Stillwater Sciences upper Napa River sampling, 2001–2005). E&L sampling of longfin smelt in the other tributaries located in the bay may help us understand longfin smelt spawning.
- The primary spawning period appears to be from December to June (Wang 1986 *as cited in* Wang 2007). Spawning may start as early as November and extends to July (Baxter *et al.*, 1999 *as cited in* Wang 2007). The majority of spawning occurs from February to April (Moyle, 2002) as documented by the DFG striped bass E&L sampling in 1992–1995 (appendix tables A6, A7, A8, A9). Spawning in the Lower Sacramento River has a more restricted period, from February to March.
- Most spawners die after spawning, but a few females may live and spawn a second time (Moyle 1976 *as cited in* Wang 2007). Older smelt spawn earlier in the season than younger ones, which may explain the extended spawning season.
- Spawning temperature ranged 7.0 – 14.5 °C (Emmett *et al.*, 1991 *as cited in* Wang 2007). Yolk-sac larvae were observed at 15.0 °C and greater from samples collected at the NBA by DFG.

6.2.2 Observations of Longfin Smelt Larvae

- Newly hatched longfin smelt are planktonic but turn into a pelagic larva when the air bladder is inflated.
- Larvae are usually found in the upper layer of the water column, preferring inshore and offshore (in channel) locations.
- The longfin smelt larvae school with other longfin smelt and delta smelt. Longfin smelt and delta smelt were often collected at the same time the project fish facilities.

- The upstream limit of spawning on the San Joaquin River is reported to be downstream of Medford Island, thus the bulk of the adult stock does not reach the influence of the export pumps, even in dry years. In wet years, the bulk of the spawning stock makes little penetration into the Delta. Because the adults are the source of the larval population, exposure of larvae to export pumping is similarly low.
- There are no years in the salvage database when longfin smelt adult salvage (Dec – March) was low, but juvenile salvage (April – June, fish greater than 20 mm) was substantial. Monthly data will show this. If adult and juvenile salvage is low, loss of larvae (<20 mm) that are not counted in salvage would have been negligible.
- Longfin smelt larvae and early juveniles prefer the LSZ in the estuary (seaward of X2), thus they leave the freshwater zone to reach the LSZ. This movement, perhaps supported by behavioral mechanisms for net downstream displacement in tidal waters, reduces their exposure to export pumping.
- Longfin smelt salvage has been low relative to other pelagic species in all years since 1994, except 2002. Because these are spawning fish, their low numbers suggest that only a small portion of the spawning stock comes within the influence of the export pumps. A small portion of the spawning stock would produce a correspondingly small proportion of the larvae population relative to the total population.
- The longfin smelt stock (as shown by the FMWT index) has recovered rapidly from very low levels in the past. These recoveries show that the abundance of longfin smelt larvae is not a critical stage in the maintenance of the adult population. The fecundity of adults is sufficient to generate a high level of recruitment from a small adult stock. There was modest recovery of the longfin smelt population in the mid-1990s following very low indices in the early 1990s. The relatively low salvage of longfin smelt from 1994 to the present suggests that export pumping is a small component of the overall population decline.
- In years with high outflows (that is, in 1980, 1982, 1983, 1984, and 1986), larvae were distributed in all regions of the estuary. They were only collected in South Bay during these high outflow years. During low outflow years, larvae were not collected in high densities outside of the west delta and Suisun Bay, though they were caught as far away as Central Bay in 1985 (Baxter 1999).

6.2.3 Observations of Longfin Smelt Juveniles

- Spring movements of juvenile longfin smelt in the South Delta were observed in 2001–2003 with a peak in 2002 (**Table 6-1**) at the CVP Tracy Fish Collection Facility (TFCF).
- Longfin smelt have similar migration behavior as delta smelt, but are not observed every year in the South Delta
- Apparently not all the longfin smelt move down Bay after hatching, especially in dry years. Ganssle (1966 *as cited in* Wang 2007) described a downstream movement of juvenile longfin smelt in Carquinez Strait, San Pablo Bay and San Francisco Bay that increased substantially during spring and summer (Messersmith 1966 and Alpin 1967 *as*

cited in Wang 2007). Large numbers of longfin smelt larvae and juveniles were captured in Suisun Bay, particular it's west side in the early 1980s (Wang 1986 *as cited i*n Wang 2007).

- Distribution ranges of juveniles were from Suisun Bay to Central San Francisco Bay from summer to winter months (Baxter *et al.*, 1999 *as cited in* Moyle 2002).
- Juveniles are abundant in the Napa River (DFG 20 mm fish sampling and Stillwater Sciences sampling).

Table 6-1. Longfin Smelt Juveniles Collected at CVP/TFCF by Reclamation, 1995 – 2005

Year	February	March	April	May	June	Total
1995	0	0	0	0	0	0
1996	0	1	2	0	0	3
1997	0	0	56	120	3	179
1998	0	0	0	0	0	0
1999	4	0	0	9	7	20
2000	0	0	21	15	1	37
2001	0	11	196	234	0	441
2002	0	34	2,835	1,124	8	4,001
2003	0	0	182	213	1	396
2004	0	2	13	14	0	29
2005	0	0	1	0	0	1

Source: Wang 2007

6.2.4 Longfin Smelt Spawning (DFG's Fish Eggs and Larval Sampling, 1992–1995)

The DFG "Striped Bass Egg and Larval (E&L) Sampling Program" generated the information on longfin smelt spawning. Sampling area covered was from Carquinez Strait to the Delta and to the Sacramento River. Sampling period was from February to July each year from 1992 to 1995 (appendix tables A6, A7, A8, and A9).

<u>1992 (Critically Dry Year in Sacramento and San Joaquin Rivers)</u>

1. Sacramento River: Selected sampling stations were sampled; few larvae were caught. Larvae were mainly observed in February and March.
2. San Joaquin River: Selective sampling stations were sampled; larvae were common toward Suisun Bay. Larvae observed in February and March.
3. Suisun Bay (south) and West Delta: Larvae were common in these areas and mainly observed in March.
4. Suisun Bay (north) and Montezuma Slough: Montezuma Slough sampling stations were not sampled in 1992; two West Delta sampling stations 65 and 66 were sampled. Larvae were common at these two stations, with most of the catch in March.
5. Comments on distribution: Spawning occurred mostly toward the Suisun Bay and West Delta. Spawning period was very short and peaking in March.

1993 (Average Year in Sacramento River and Wet Year in San Joaquin River)

1. Sacramento River: Very few larvae were collected in the lower sampling stations in March.
2. San Joaquin River and West Delta: Most larvae were at the lower reaches of the San Joaquin River; peaking in February and March.
3. Suisun Bay (south) and West Delta: Larvae concentrated in these areas in February to May.
4. Suisun Bay (north) and Montezuma Slough: Larvae concentrated in these areas in February to May.
5. Comments on distribution: Most of the spawning occurs in Suisun Bay, Montezuma Slough, and West Delta; less in the inland Delta waters. Larvae abundant from February to May.

1994 Critically Dry Year in the Sacramento and San Joaquin Rivers)

1. Sacramento River: Larvae were observed at all sampling stations located in the lower reaches of the Sacramento River. Peak abundance was from February to April.
2. San Joaquin River: Larvae were abundant over the entire sampling stations, and peak abundance was from February to April.
3. Suisun Bay (south) and West Delta: Larvae were very abundant these areas, peaking in February to early April.
4. Suisun Bay (north) and Montezuma Slough: Larvae were very abundant in these areas and peaked in February to mid April.
5. Comments on distributions: Heavy spawning occurred in Suisun Bay, Montezuma Slough, and West Delta; spawning also occurred in the lower reaches of the Sacramento and San Joaquin Rivers. Spawning occurred in February to April with a peak in March; larvae were very abundant.

1995 (Wet Year in the Sacramento and San Joaquin Rivers)

1. Sacramento River: Few larvae were observed at the lower reaches of Sacramento River and no peak in abundance was observed.
2. San Joaquin River: Few larvae were observed and no peak.
3. Suisun Bay (south) and West Delta: Some larvae were observed in late February and early March.
4. Suisun Bay (north) and Montezuma Slough: Some larvae were observed mainly in February and March.
5. Comments on distribution: Spawning was light in all four areas, and larvae were present for a very short duration.

Judging from the relatively low abundance of longfin smelt larvae collected from the DFG striped bass E&L surveys from 1992–1995, it can be stated that:

1. Longfin smelt general spawning does not always correlate with Delta outflow. During critically-dry water years, such as 1994, longfin smelt move to the Suisun Bay to spawn. In wet water years, such as 1995, longfin smelt descend to the San Pablo Bay to spawn. However, intensive spawning also occurs in the upper Estuary in dry water years. The success of longfin smelt spawning may involve multiple environmental factors. In some years, Delta outflow may be a factor; however, longfin smelt larval abundance does not always correlate to Delta outflow (Baxter *et al.*, 1999 *as cited in* Moyle 2002).
2. Longfin smelt may spawn in brackish water. Longfin smelt is thought to be a freshwater spawner. However, large numbers of longfin smelt yolk-sac larvae were also observed at the west end of Suisun Bay near Carquinez Strait (oligohaline) during the dry years.
3. The majority of longfin smelt larvae and juveniles stay in the Delta between February and April (this study). The juveniles move into Suisun Bay (Ecological Analysts Inc. sampling in the vicinity of Pittsburg and Contra Costa power plants in 1978–1982) and further down to San Pablo and Central Bays (Baxter *et al.*, 1999 *as cited in* Moyle 2002).
4. Longfin smelt use the Delta, the Lower Sacramento River, and tributaries of Montezuma Slough as their primary spawning area. Suisun Bay is used as a nursery area, especially during dry years.
5. Some longfin smelt larvae are found in the Cache Slough area, regardless of the type of water year.

Baxter (2008) depicts the relationship between water year type (i.e., wet versus dry) as discussed above. Baxter (2008) also noted that during years when high outflows occur when larvae are being transported downstream, most larvae are transported to Suisun and San Pablo Bays; during years with lower outflow, larvae are transported into the western Delta and Suisun Bay (Baxter 2000, Baxter et al. 1999, *as cited in* Moyle 2002). The center of distribution of longfin smelt larvae varies with outflow conditions and is closely associated with the low-salinity zone (LSZ) (indexed as X2); the center of distribution is consistently seaward of X2 (Dege and Brown 2004, *as cited in* Reclamation 2008).

6.2.5 Longfin Smelt Spawning at Three Sampling Locations

DFG had conducted the striped bass E&L sampling in the Sacramento-San Joaquin Delta for 8 years (1988–1995). After 1995, sampling of fish E&L was concentrated in two areas, the NBA and the Suisun Marsh. In addition, longfin smelt (mainly juveniles) were seasonally collected at the CVP/TFCF.

6.2.5.1 NBA

Larvae longfin smelt were seldom caught near Elk Grove (Sample Station # 71) on the Sacramento River. Larval fish taken at Cache and Lindsey sloughs represent the northernmost (upriver) spawning location in the Sacramento River for this species.

Three points are made regarding longfin smelt use of this area:

1. The usage of this area for spawning was not intense until 2002 (**Table 6-2**). In that year a spawning spike occurred in February and March, and then subsided in April. A similar pattern was observed for longfin smelt abundance in Suisun Bay and at the fish salvage facilities.
2. Longfin smelt share the same spawning ground with delta smelt.
3. Cache/Lindsey Slough area receives flows from upper Sacramento River via Miner Slough and Steamboat Slough, and has a complex secondary channel network. Furthermore, flows from this area are also enhanced by the tidal movements that allow for constant aeration of eggs. This appears to be an ideal location for not only smelt spawning but many other fish species as well (Wang and Reyes 2005 *as cited in* Wang 2007).

Table 6-2. Longfin Smelt Larvae and Juveniles Collected at NBA by DFG in Fish E&L Sampling Program, 1993–2004

Year	February	March	April	May	June	Total
1993	0	5	0	0	0	5
1994	155	177	42	3	0	377
1995	27	33	2	0	0	62
1996	0	0	0	0	0	0
1997	97	352	98	4	0	551
1998	0	0	0	0	0	0
1999	12	12	17	0	0	29
2000	2	0	2	1	0	5
2001	1,219	980	81	10	0	2,290
2002	104,945	11,687	928	58	1	23,168
2003	302	572	116	7	0	997
2004	351	13	1	0	0	365

Notes: 1) Quality control on longfin smelt identification was performed by this author; 2) Longfin smelt identification was performed by DFG biologists in 2003 and 2004.

Table 6-3. Longfin smelt larvae and juveniles collected at Suisun Marsh by UC Davis in fish E&L sampling program, 1995–2002

Year	February	March	April	May	June	Total
1995	18	2	3	0	0	23
1996	94	72	16	27	2	211
1997	291	481	256	24	0	1,052
1998	0	16	1	0	0	17
1999	126	37	117	3	0	283
2000	796	84	189	32	0	401
2001	1,028	1,859	234	9	0	3,130
2002	4,966	5,038	307	15	0	10,326

6.2.6 Suisun Marsh

Suisun Bay, Suisun Marsh, Montezuma Slough, and West Delta are the historical spawning grounds for longfin smelt (Moyle 1976 and Wang 1986, 1991 *as cited in* Wang 2007). Information on spawning indicates (**Table 6-3)** that Suisun Marsh has been used as spawning habitat by longfin smelt and delta smelt for many years, and more recently in 1995, by the wakasagi. Three points are made from longfin smelt use of this area:

1. Longfin smelt spawn in the Montezuma Slough and its tributaries; the Cordelia Creek having the highest numbers of longfin smelt larvae collected in 2001 and 2002.
2. The entrapment zone of these tributaries is limited in size (length and width), and it leads one to believe that longfin smelt may spawn in freshwater as well as in brackish water.
3. Due to the spawning habitat limitation, timing of local tributaries run-off, and water temperatures, the intensive spawning occurs mainly in February, March, eventually subsiding in April.

6.2.7 Central Valley Project Fish Facility Observations

Mainly juvenile longfin smelt are observed at the CVP/TFCF. Five points are made from the presence of longfin smelt at the CVP/TFCF.

1. Adult longfin smelt were observed at the CVP/TFCF on rare occasions during winter months, and very few larvae were collected in the South Delta by Spaar (1990a; 1990b; 1991; 1992, and 1993 and Spaar and Wadsworth 1994 *as cited in* Wang 2007).
2. Longfin smelt seldom appeared in the South Delta in the second half of the1990s with the exception of 1997. During this year longfin smelt were found to be moderately abundant at the CVP/TFCF.
3. Sampling in 2001–2003 showed the greatest number of the longfin smelt in the South Delta, with a dramatic spike in April and May, 2002.
4. Small number of longfin smelt larvae was collected in the CVP/TFCF during 2001 and 2003. It is believed these numbers indicate that some longfin smelt may have shifted their spawning towards the South Delta.
5. Judging from the juvenile fish length distributions at the CVP/TFCF in 2002, juveniles arrived in several pulses. This behavior is similar to that of delta smelt, namely moving into the South Delta before migrating to the down bay rearing habitat.

6.3 Effect of Changes on Adult and Juvenile Longfin Smelt

The BO's RPA actions targeting OMR flows are also intended to improve conditions influencing habitat as well as vulnerability to entrainment for delta smelt. Reducing the magnitude of negative flows in OMR likely involve reductions in export pumping that, under the conditions that would typically trigger the changes, would also improve location of X2, moving it more seaward and reducing risk of longfin smelt entrainment, increase delta outflow, and reduce the E/I ratio, reducing the risk of entrainment, especially of larva and post-larval life stages, as discussed below.

6.3.1 OMR Flows

Since the purpose of RPA components 1 and 2 are to reduce adult juvenile and larval delta smelt entrainment by reducing the magnitude of negative OMR flows the concept of reducing OMR flows to reduce entrainment should also apply to longfin smelt. This would assume that the vulnerability of both species is essentially equal. However, longfin smelt appear to be less vulnerable to entrainment due to substantial differences in behavior and life history. For example, it appears that longfin smelt adults are typically located outside the areas with high vulnerability to entrainment. Relatively few adult longfin smelt are salvaged annually (**Figure 6-1**).

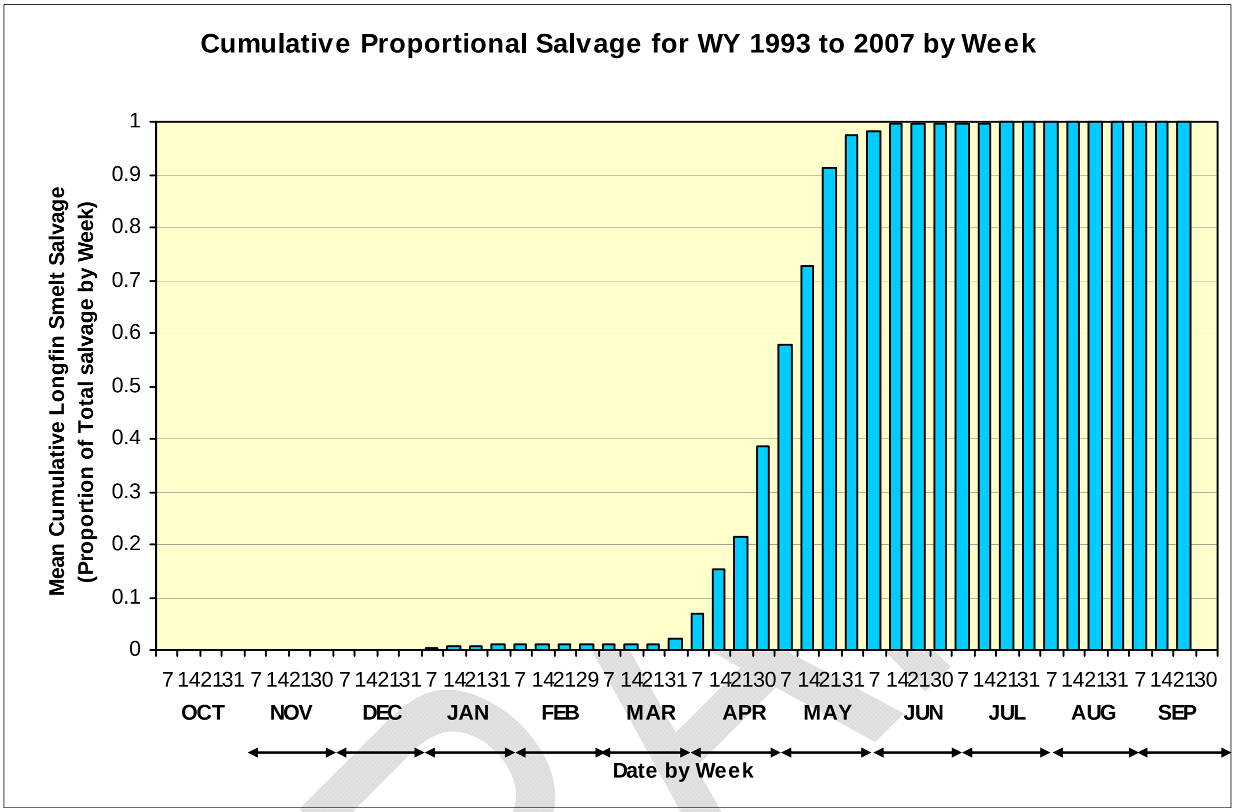
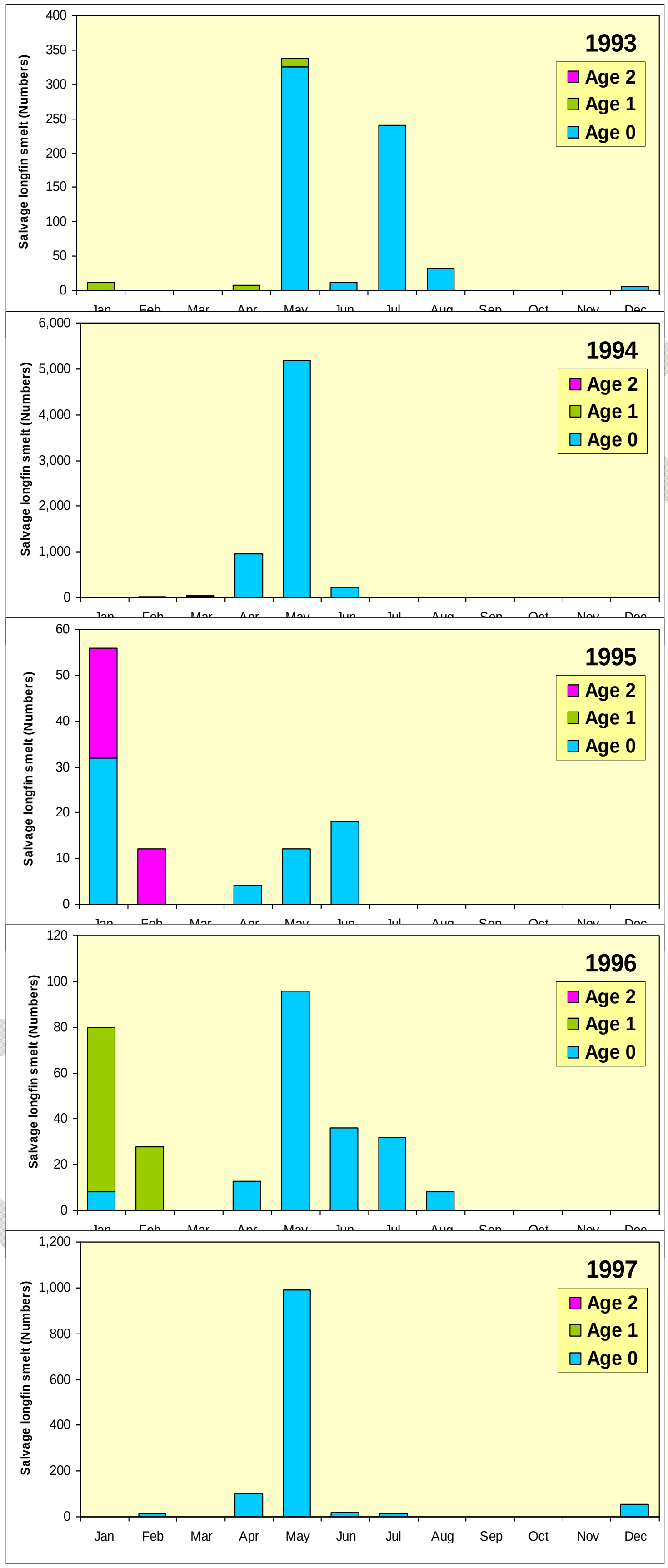


Figure 6-1. Cumulative Proportion Salvage for Water Years 1993 to 2007 by Week

Juvenile longfin smelt (primarily age 0) appear much more susceptible to entrainment. Age 0 longfin comprise the majority of salvaged longfin smelt as shown in **Figure 6-2**. Curiously, the 20 mm trawl results show the distribution of longfin smelt to generally be well downstream of the potential entrainment zone during the period of highest entrainment (mid-March-June) (**Figure 6-3**). These observations could suggest that entrainment removes sufficient numbers of longfin smelt from the sampling areas representing the more entrainment-prone areas, the sample sites are not representing the relative occurrence of longfin smelt juveniles within the entrainment-prone areas, or entrainment is episodic, potentially reflecting the schooling nature of these fish, and that the salvage numbers represent entrainment during periods of excursion into the entrainment area.

SWC (2008) note that during the year with the greatest level of salvage (2002), the distribution of longfin smelt as defined by results of the 20 mm trawl, was primarily west and north of the perceived entrainment zone (Figure 6-3).


1993
Age 2
Age 1
Age 0
Salvage longfin smelt (Numbers)
0
50
100
150
200
250
300
350
400
1994
Age 2
Age 1
Age 0
Salvage longfin smelt (Numbers)
0
1,000
2,000
3,000
4,000
5,000
6,000
1995
Age 2
Age 1
Age 0
Salvage longfin smelt (Numbers)
0
10
20
30
40
50
60
1996
Age 2
Age 1
Age 0
Salvage longfin smelt (Numbers)
0
20
40
60
80
100
120
1997
Age 2
Age 1
Age 0
Salvage longfin smelt (Numbers)
0
200
400
600
800
1,000
1,200
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

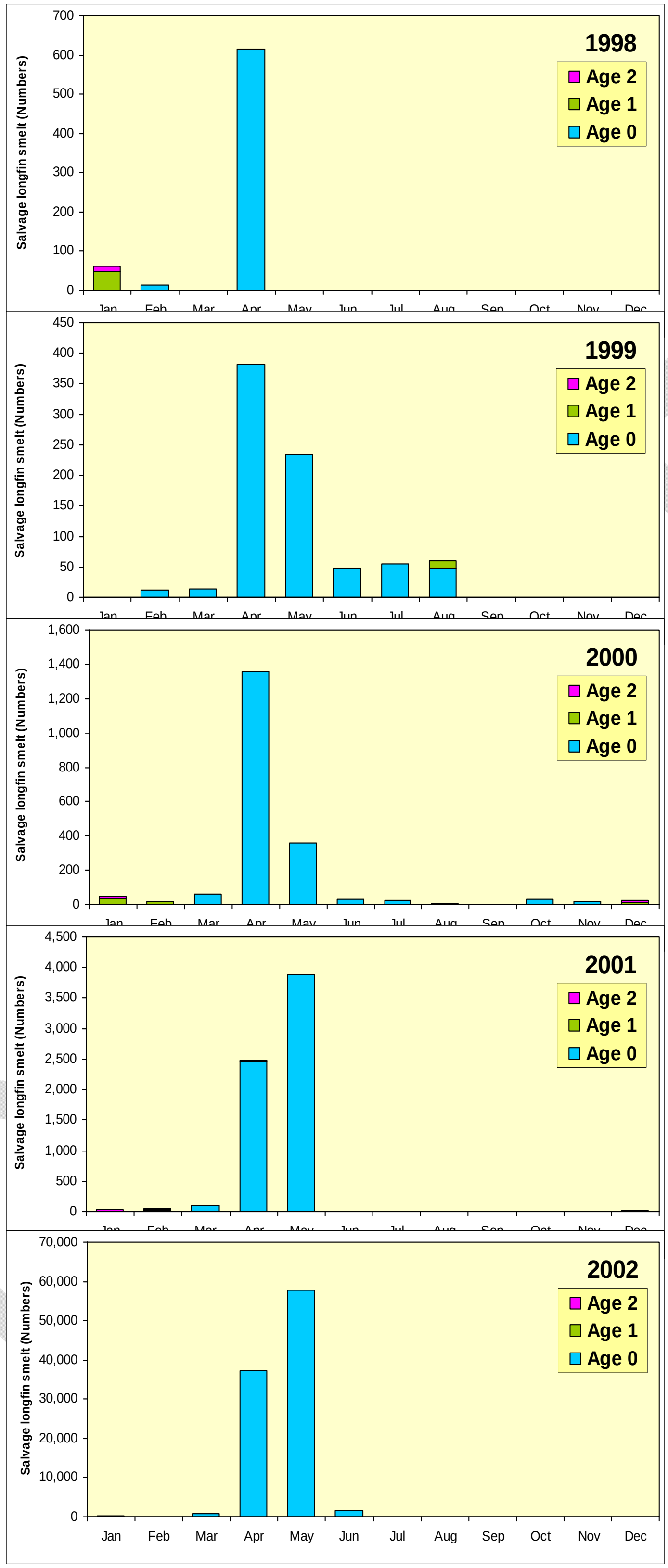


Figure 6-2. Salvage of Longfin Smelt by Age Classification (age-0, age-1, and age-2) from 1993 to 2002.

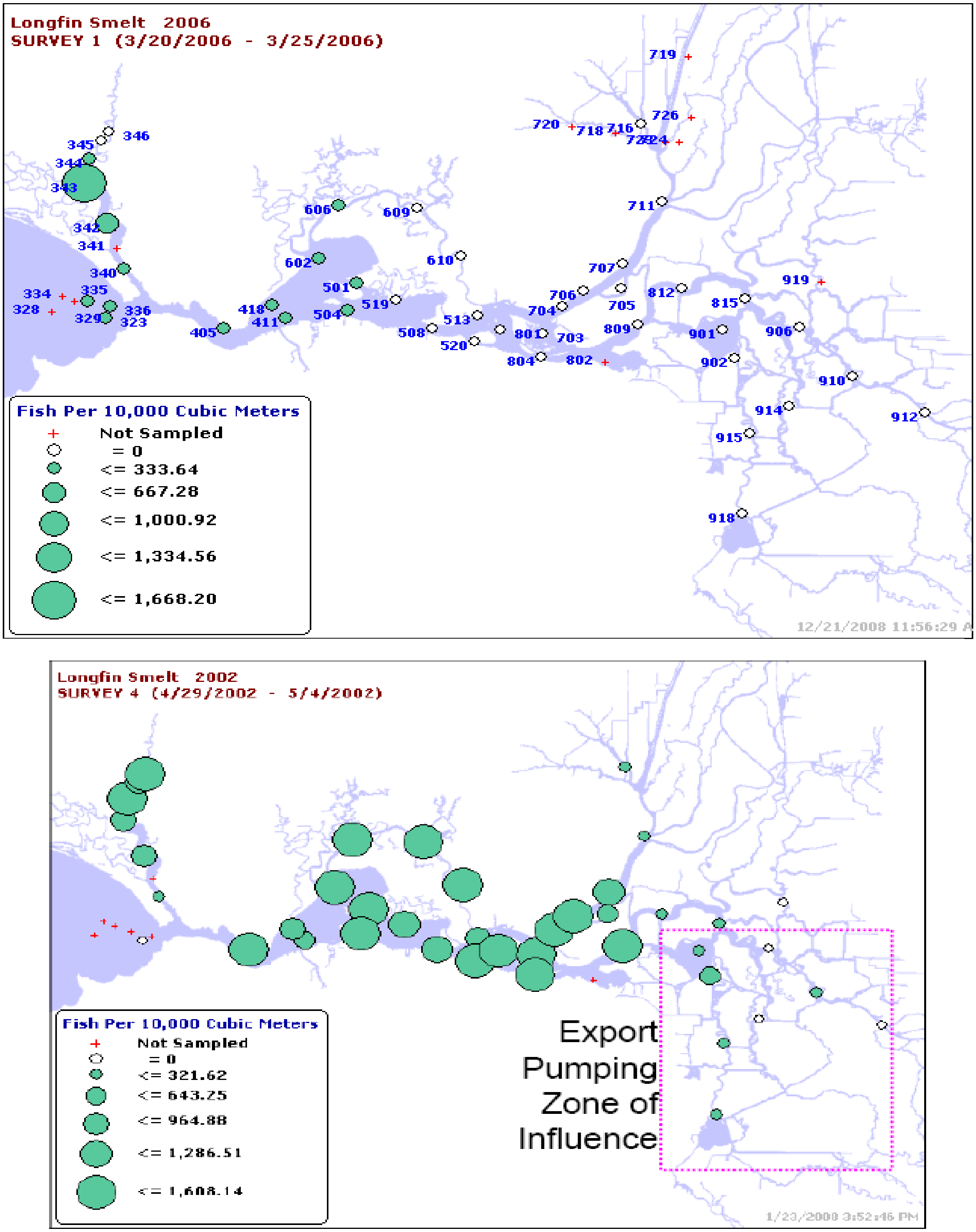


Figure 6-3. Distribution of Longfin Smelt During Spring 2002 Coincident with the Highest Level of Salvage Measured at the Export Salvage Facilities (SWC 2008)

6.3.1.1 OMR – Salvage Relationships

We evaluated the potential to predict longfin smelt salvage from OMR flows following a linear regression approach akin to the one developed by Grimaldo et al. (accepted manuscript) for delta smelt (USFWS 2008). Because longfin smelt may spawn as early as November and as late as June, and because adult longfin smelt classified as Age 1 and Age 2 fish (presumably spawners) appear in the SWP and CVP combined salvage mostly from December through February, while Age 0 longfin smelt (juveniles that are smaller than 46 mm FL in March and smaller than 71 mm FL by July) constitute most of the salvage from March through July, two regression analyses were performed. The first regression analysis, thought to study the impact of OMR flows on spawning adults, describes the cumulative salvage numbers of longfin smelt present from December to the subsequent February during the water years 1993 through 2007 as a linear function of the average OMR daily flows in the December-February periods (N = 15). The second regression analysis, thought to study the impact of OMR flows on juveniles, describes the cumulative salvage numbers of longfin smelt present from March through July during the water years 1993 through 2007 as a linear function of the average OMR daily flows in the March-July periods (N = 15).

The OMR flows are the sum of flows at Middle River and Old River. Daily flows at Middle River were downloaded from the USGS website (http://waterdata.usgs.gov/ca/nwis/dv/?referred_module=sw). They were measured daily at USGS gage station 11312676 (MIDDLE R AT MIDDLE RIVER CA) since January 1987, but with considerable interruptions during the study period December 1, 1992 through July 31, 2007. Daily flows at Old River were those measured daily at USGS gage station 11313405 (OLD R A BACON ISLAND CA) since January 1987, that also have considerable interruptions during the study period December 1, 1992 through July 31, 2007. Because of the lack of a continuous series of daily flows at both the Middle and Old River gages during the study period December 1, 1992 through July 31, 2007, a continuous record of daily OMR flows was generated by applying a linear regression relating the sum of daily flows measured at Middle and Old River gages with the daily values for the DAYFLOW variables EAST, EXPORT and SJR for the 5,733 days for which there were records at both USGS gages. This approach is similar to the one used in the delta smelt (USFWS 2008). The values of the DAYFLOW variables were downloaded from the website http://iep.water.ca.gov/dayflow/index.html.

The final linear regression used to generate the daily OMR flows was:

$$OMR = -1040.425 + 0.0880 \times EAST - 0.83570 \times EXPORT + 0.4918 \times SJR$$

which had a coefficient of determination (r^2) equal to 0.952.

The regression analysis that describes the cumulative salvage numbers of longfin smelt present from December to the subsequent February during the water years 1993 through 2007 ($Y_{DEC\text{-}FEB}$) as a linear function of the average OMR daily flows in the December-February ($OMR_{DEC\text{-}FEB}$) periods produced the following equation:

$$Ln(Y_{DEC\text{-}FEB} + 1) = 3.35266076 - 0.00011359 \times OMR_{DEC\text{-}FEB}$$

which was not significant (P = 0.163) and has $r^2 = 0.14$ (**Figure 6-4)**

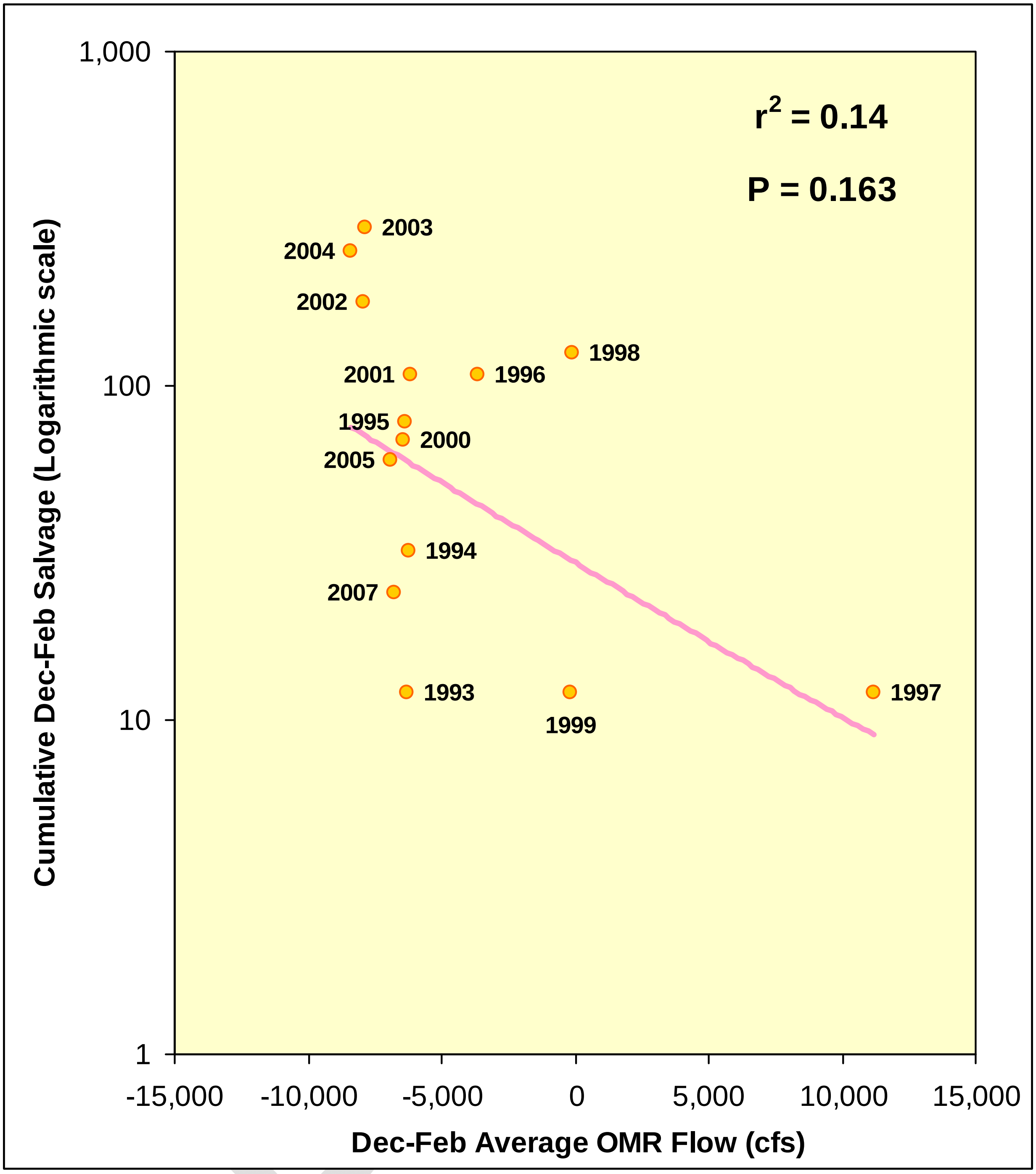


Figure 6-4. Cumulative Salvage Numbers of Longfin Smelt Present from December to the Subsequent February During the Water Years 1993 through 2007

The regression analysis that describes the cumulative salvage numbers of longfin smelt present from March through July during the water years 1993 through 2007 ($Y_{MAR\text{-}JUL}$) as a linear function of the average OMR daily flows in the March-July ($OMR_{MAR\text{-}JUL}$) periods produced the following equation:

$$\text{Ln}(Y_{\text{MAR-JUL}} + 1) = 5.55642376 - 0.00041806 \times \text{OMR}_{\text{MAR-JUL}}$$

which was significant (P = 0.020) and has $r^2 = 0.35$ (**Figure 6-5)**

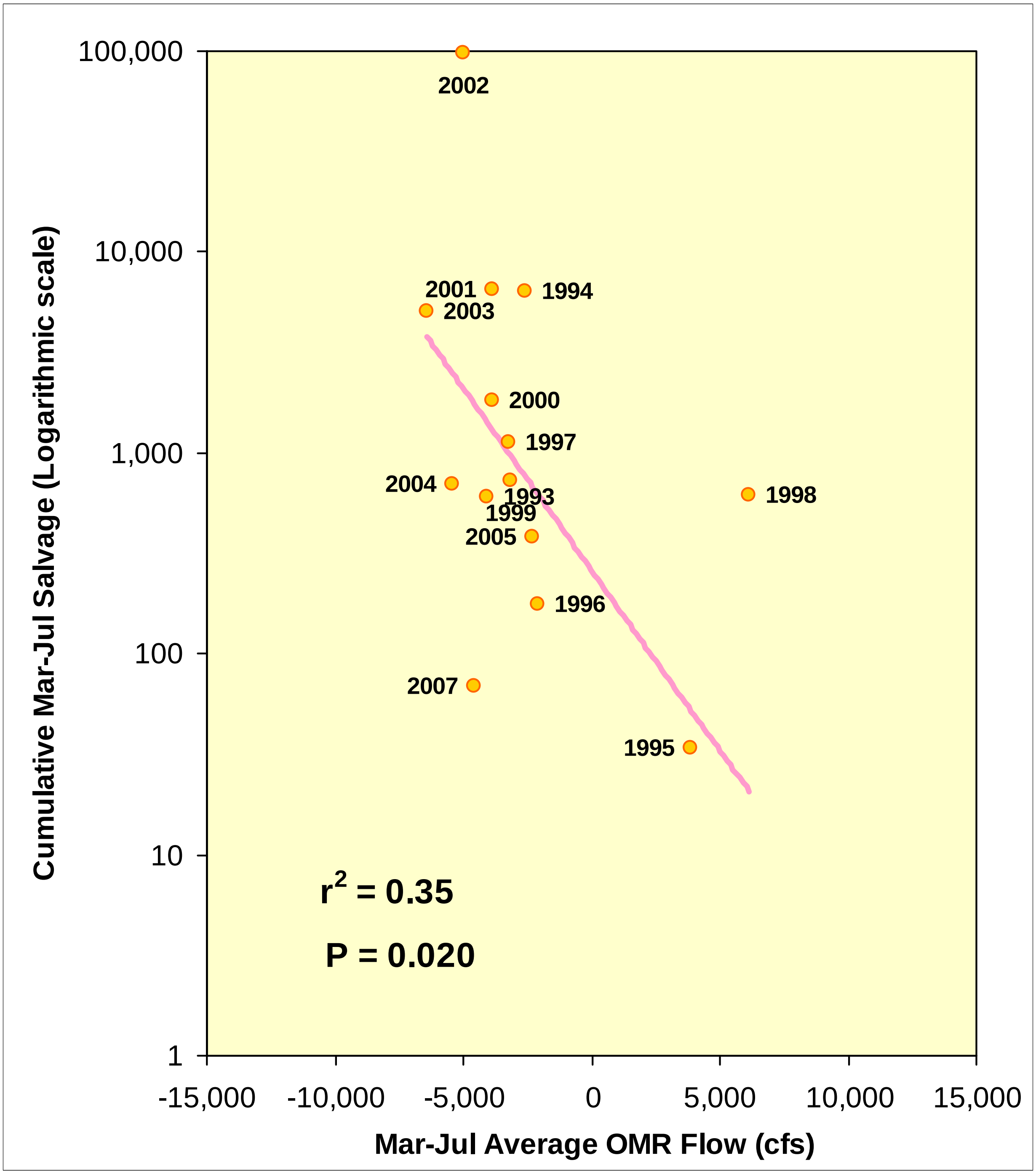


Figure 6-5. Cumulative Salvage Numbers of Longfin Smelt Present from March through July During the Water Years 1993 through 2007

Herbold et al. (2005) reports that recent conditions resulting from increased exports and negative changes in hydrodynamic indicators of effect, may have resulted in a greater vulnerability of adult longfin smelt to entrainment. Herbold et al. (2005) found that indicators of vulnerability measured in terms of salvage and abundance (FMWT indices) showed adult longfin smelt entrainment to be more susceptible to OMR flows and increased X2 as OMR became more negative, X2 become higher and the E/I ratio increased.

6.4 Conclusion

Typically, vulnerability of adult longfin smelt to entrainment is not significantly related to OMR. However, as OMR increases to the levels observed during the recent eight years, the vulnerability of adults to entrainment increased demonstrating either a response to OMR magnitude, outflow or X2. The implementation of RPA Component 1 actions would result in reduction in the occurrence of high, negative OMR flows during the adult migration and spawning periods. The result should be extremely low or no entrainment in wet years and a substantial decrease in entrainment during dry years (compared to the pre 2003 when there was no evident relationship between OMR and adult salvage). Furthermore, the substantial increase in salvage (magnitude and relative to abundance indices) occurring from 2003 to 2007 that Herbold et al. (2005) attribute to substantial increases in export relative to inflow, would be avoided pursuant to implementation of RPA component 1 actions.

6.4.1 X2 and Delta Outflow

Implementation of RPA component 1 actions is intended to result in decreased X2 (more seaward location) and increased delta outflow during the adult migration, spawning, and early juvenile (age 0) rearing periods. The result would be a decrease in vulnerability to entrainment and improvement in rearing habitat conditions reflected by a westward movement of X2 and increased outflow during spring.

The relationship between longfin smelt abundance and late-winter through spring outflow has been well reported (Hieb and Baxter 1993) (**Figures 6-6 and 6-7)**.

The influence of X2 on entrainment was evaluated using salvage data for adults and juveniles as follows. The potential to predict longfin smelt salvage from X2 and Delta Outflows was studied following a linear regression approach.
X2 is one of the output variables generated by the program DAYFLOW (website http://iep.water.ca.gov/dayflow/index.html). In DAYFLOW, X2 is calculated using the Autoregressive Lag Model: $X2(t) = 10.16 + 0.945*X2(t-1) - 1.487 \times \log_{10}(OUT(t))$, where OUT is the Delta Outflow, t is the current day and t-1 is the previous day. DAYFLOW generates daily X2 values starting on 10/1/1996. The Delta Outflow is the output variable OUT whose daily values DAYFLOW generates from 10/1/1955. Because longfin smelt may spawn as early as November and as late as June, and because adult longfin smelt classified as Age 1 and Age 2 fish (presumably spawners) appear in the SWP and CVP combined salvage mostly from December through February, while Age 0 longfin smelt (juveniles that are smaller than 46 mm FL in March and smaller than 71 mm FL by July) constitute most of the salvage from March through July, two regression analyses were performed for each of the two explanatory variables (i.e., X2 and Delta Outflow).

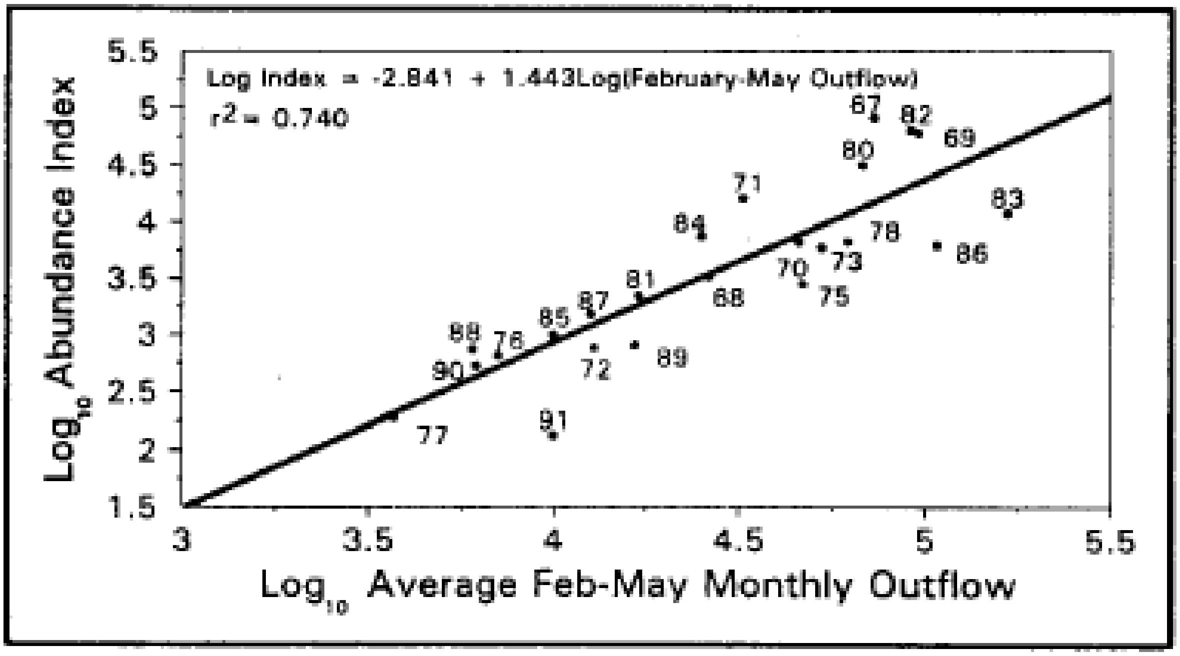


Figure 6-6. Relationship Between Log_{10} of the FMWT Longfin Smelt Abundance Index and Log_{10} of the Average February-May Outflow at Chipps Island (Hieb and Baxter 1993).

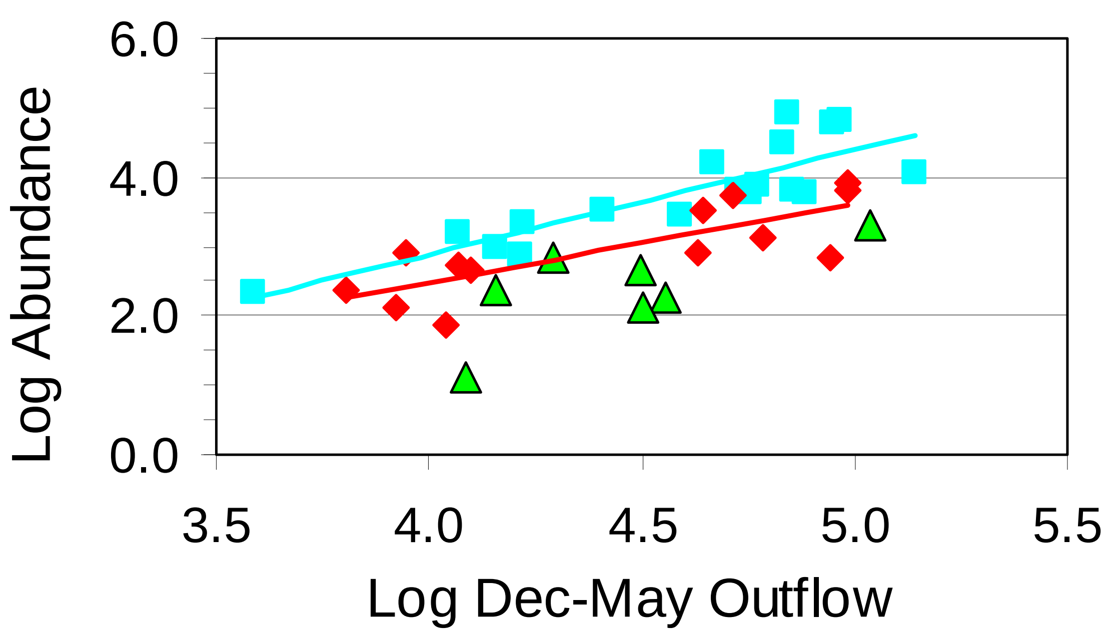


Figure 6-7. Relationship Between Log_{10} of the FMWT Longfin Smelt Abundance Index and Log_{10} of the Average December-May Outflow at Chipps Island (Baxter 2008).

The first set of regression analyses, thought to study the impact of the explanatory variables on spawning adults, describes the cumulative salvage numbers of longfin smelt present from December to the subsequent February during the water years 1993 through 2007 as a linear function of the average Delta Outflows in the December-February periods (N = 15), or the cumulative salvage numbers of longfin smelt present from December to the subsequent February during the water years 1997 through 2007 as a linear function of the average X2s in the December-February periods (N = 11). The second set of regression analyses, thought to study the impact of the explanatory variables on juveniles, describes the cumulative salvage numbers of longfin smelt present from March through July during the water years 1993 through 2007 as a linear function of the average Delta Outflows in the March-July periods (N = 15), or the cumulative salvage numbers of longfin smelt present from March through July during the water years 1997 through 2007 as a linear function of the average X2s in the March-July periods (N = 11).

The regression analysis that describes the cumulative salvage numbers of longfin smelt present from December to the subsequent February during the water years 1997 through 2007 ($Y_{DEC\text{-}FEB}$) as a linear function of the average daily X2 in the December-February ($X2_{DEC\text{-}FEB}$) periods produced the following equation:

$$\mathrm{Ln}(Y_{DEC\text{-}FEB} + 1) = -2.046009335 + 0.086464156 \times X2_{DEC\text{-}FEB}$$

that was not significant ($P = 0.217$) and had $r^2 = 0.16$ (**Figure 6-8)**

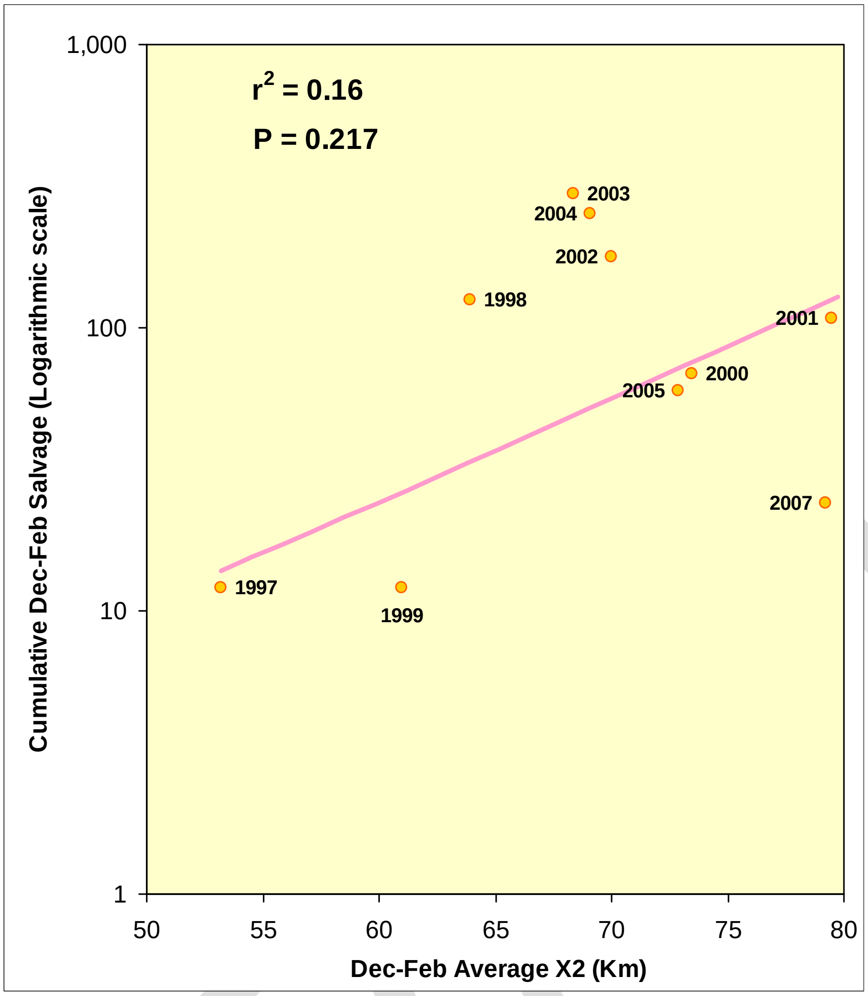


Figure 6-8. Cumulative Salvage Numbers of Longfin Smelt Present from December to the Subsequent February During the Water Years 1997 through 2007

The regression analysis that describes the cumulative salvage numbers of longfin smelt present from March through July during the water years 1997 through 2007 ($Y_{MAR\text{-}JUL}$) as a linear function of the average daily X2 in the March-July ($X2_{MAR\text{-}JUL}$) periods produced the following equation:

$$Ln(Y_{MAR\text{-}JUL} + 1) = -6.495295264 - 0.195415042 \times X2_{MAR\text{-}JUL}$$

that was not significant ($P = 0.081$) and had $r^2 = 0.30$ (**Figure 6-19)**

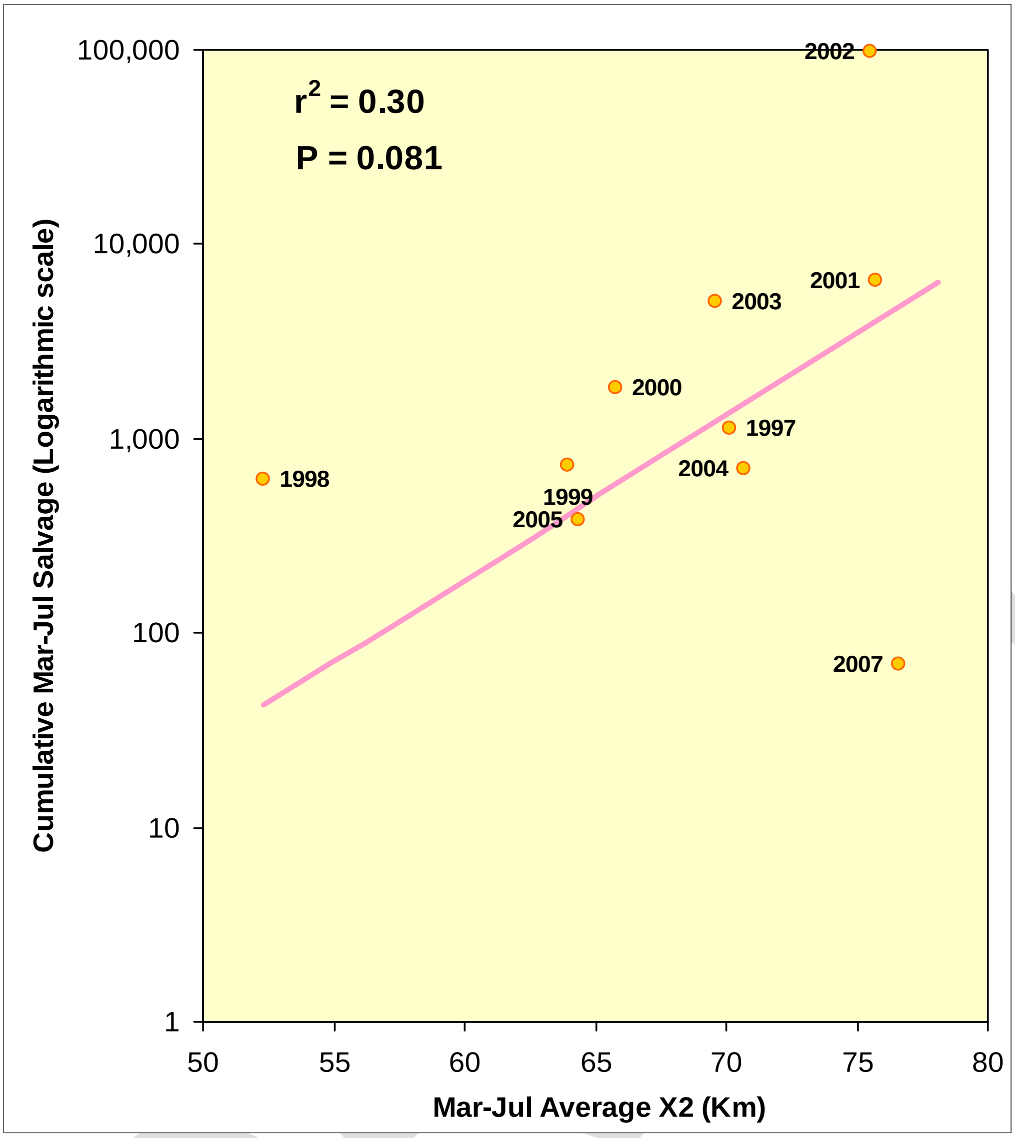


Figure 6-9. Cumulative Salvage Numbers of Longfin Smelt Present from March through July During the Water Years 1997 through 2007

The regression analysis that describes the cumulative salvage numbers of longfin smelt present from December to the subsequent February during the water years 1993 through 2007 ($Y_{DEC\text{-}FEB}$) as a linear function of the average daily Delta Outflow in the December-February ($OUT_{DEC\text{-}FEB}$) periods produced the following equation:

$$Ln(Y_{DEC\text{-}FEB} + 1) = 4.507850668 - 0.000012740 \times OUT_{DEC\text{-}FEB}$$

that was not significant ($P = 0.228$) and had $r^2 = 0.11$ (**Figure 6-10)**

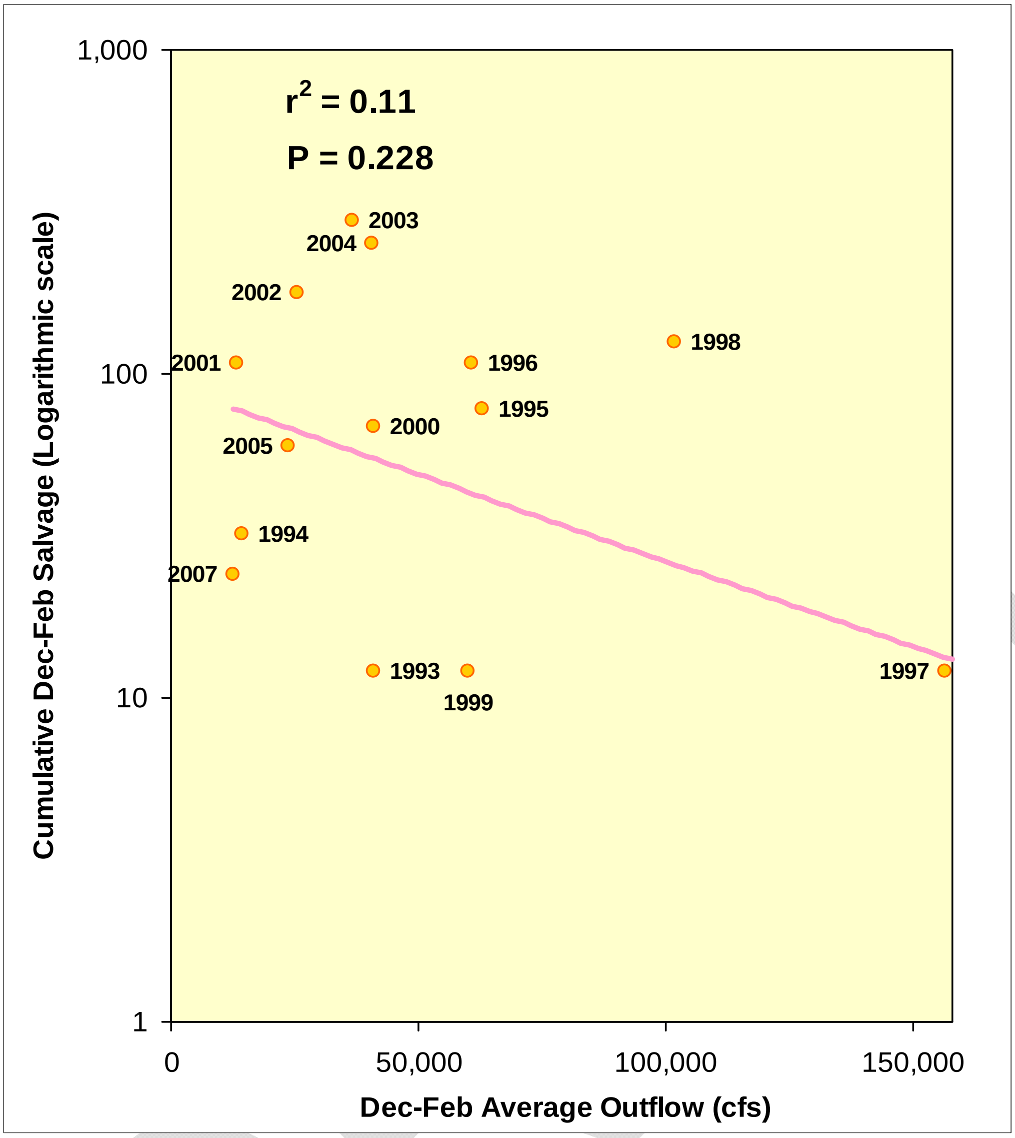


Figure 6-10. Cumulative Salvage Numbers of Longfin Smelt Present from December to the Subsequent February During the Water Years 1993 through 2007

The regression analysis that describes the cumulative salvage numbers of longfin smelt present from March through July during the water years 1993 through 2007 ($Y_{MAR-JUL}$) as a linear function of the average daily Delta Outflow in the March-July ($X2_{MAR-JUL}$) periods produced the following equation:

$$\mathrm{Ln}(Y_{MAR-JUL} + 1) = 8.790430338 - 0.000068125 \times OUT_{MAR-JUL}$$

that was significant ($P = 0.003$) and had $r^2 = 0.50$ (**Figure 6-11)**

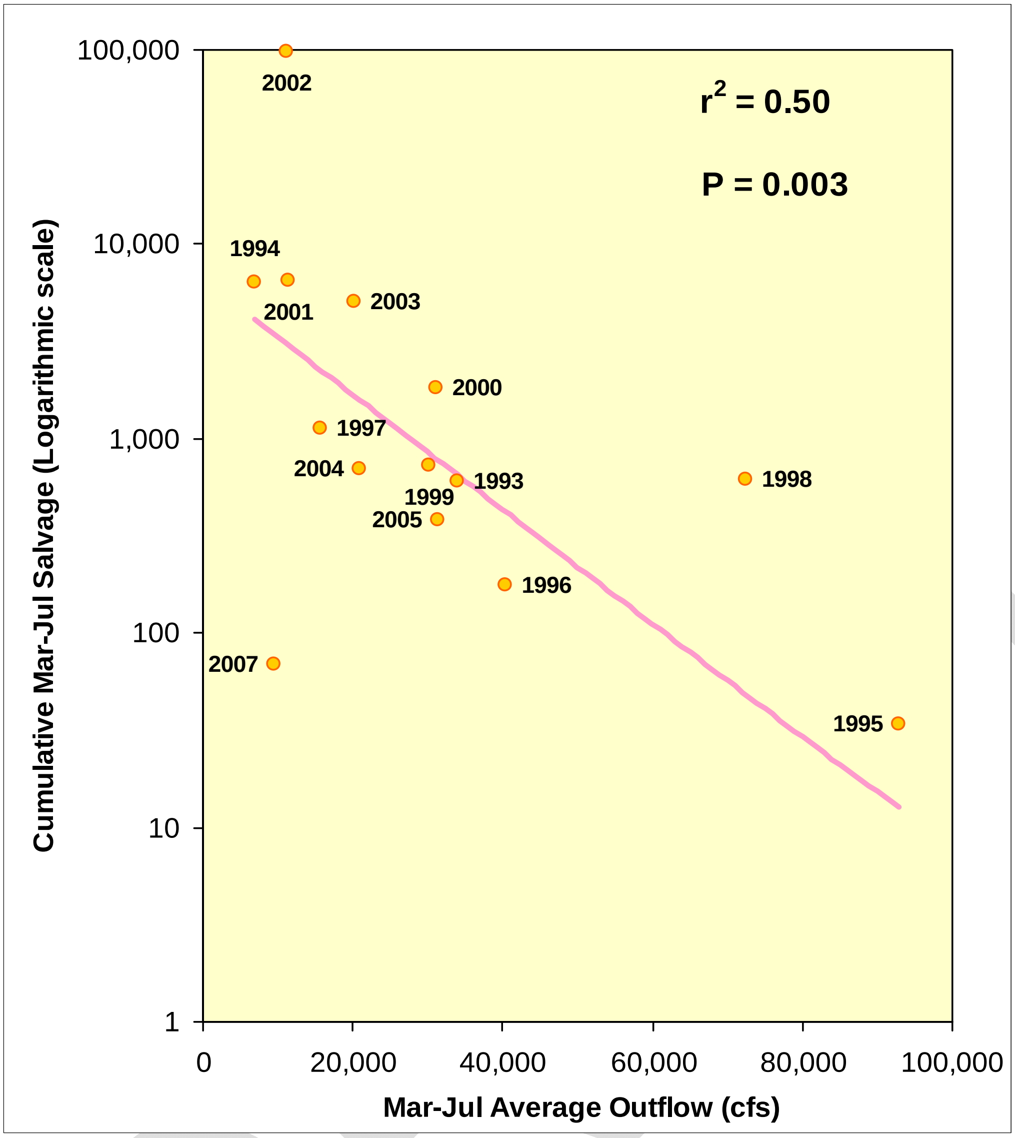


Figure 6-11. Cumulative Salvage Numbers of Longfin Smelt Present from March through July During the Water Years 1993 through 2007

6.4.2 Export:Inflow Ratio (E/I)

Herbold et al. (2005) observed a relationship between the E/I ratio and salvage (entrainment) based on the relationship between particle entrainment and E/I ratio (**Figure 6-12**). They concluded that the average November-March E/I ratio for 1994-2000 was 24% whereas the average for 2001 to 2005 was 36%. The most striking difference from water year 1995-2005 was the general lack of very low (< 20%) export:inflow ratios for the 2001-2005 period (Figure 9). These results suggest that recent-year changes in exports in relation to inflow would change the fate of modeled particles and by extension, probably increase both fish salvage and fish salvage densities at the facilities. Virtually all particles close to the export facilities would be entrained, while almost twice as many particles could be entrained from more remote sites (e.g., Twitchell Island). Combined with decreases in San Joaquin flow peaks and increased use of agricultural barriers, these results suggest Delta hydrodynamics may have been substantially altered during the last 5 years. Although these results provide a likely hydrodynamic mechanism for the recent increases in wintertime fish salvage, a much more intensive empirical modeling effort is appropriate.

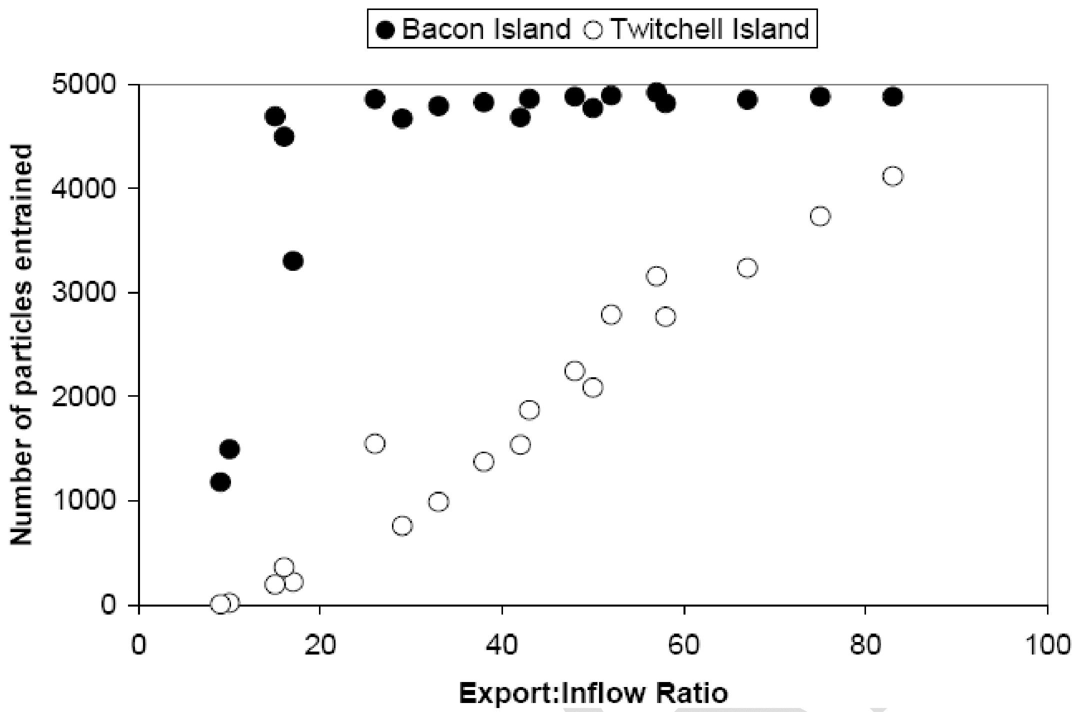


Figure 6-12. Relationship Between E/I Ratio and Number of Particles Entrained

Conclusion. The implementation of RPA component 1 will result in reduced magnitude of negative OMR flows throughout the juvenile rearing period. Currently, the majority of longfin smelt entrained by the project are Age 0 juveniles; reductions in OMR along with a decrease in X2 (locate further west) will benefit Age 0 juveniles by reducing entrainment vulnerability and providing improved habitat conditions. In addition, increased delta outflow should greatly benefit longfin smelt abundance. Finally, the conditions attributed to increased entrainment since 2003 will not be possible under the BO and RPA component 2, providing opportunity for a positive response in the longfin smelt population as juvenile abundance increases.

6.4.3 Larval Evaluation

The implementation of RPA component 2 is intended to protect larval and juvenile delta smelt by reducing entrainment and improving habitat conditions. The actions associated with this RPA component are specifically directed at reducing the magnitude of negative OMR flows from larval emergence through juvenile rearing (typically mid-February through June).

Longfin smelt larvae are considered to be as or even more vulnerable to entrainment as delta smelt larvae, given the same location and hydrodynamic conditions (Baxter pers. Comm. 2008). Longfin smelt larvae are oriented toward the surface until they develop the ability to vertically migrate. During this phase they are totally planktonic (free floating) while delta smelt larvae are neutrally buoyant, which suggests that there may be differences in the way the two larval forms respond to hydrodynamic conditions. Longfin smelt larvae are more inclined to freely move downstream to more productive habitat, which may make them more susceptible to reverse flows thus entrainment. DWR and DFG are currently evaluating the potential differences in entrainment vulnerability using a particle tracking model developed to follow particle movement throughout the delta as a function of hydrodynamics and location. The particles are considered to represent the movement of fish larvae and can be modeled to reflect any differences depending upon the larvae's location within the water column. The results of the investigations should identify any differences in "behavior" of the particles (free floating versus neutrally buoyant) to refine evaluation of the effects of OMR and related conditions on entrainment of longfin smelt larvae.

Factors influencing the longfin smelt larvae include OMR and its effect on entrainment vulnerability, the location of X2 as it effects both spawning location, thus location of larva during the planktonic stage and entrainment vulnerability, and on habitat conditions conducive to larval growth and survival.

Longfin smelt larvae temporal and geographical distribution is directly related to timing and location of spawning. As discussed above, the adult migration and spawning can occur as early as November and typically occurs from January through March (**Figures 6-13 and 6-14**). Spawning location is associated with the location of X2 (Dege and Brown 2004), which is influenced by export levels, especially within dry years.

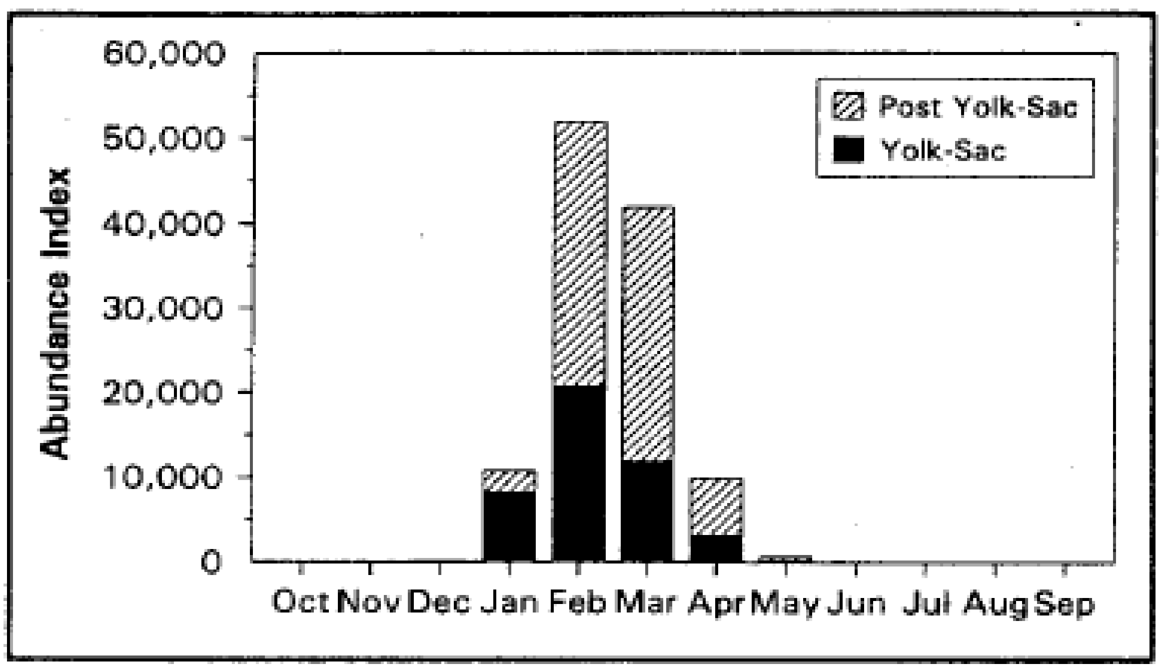


Figure 6-13. Average Monthly Abundance Index for Yolk-sac and Post-yolk-sac Longfin Smelt Larvae, 1980-1988 (Heib and Baxter 1993)

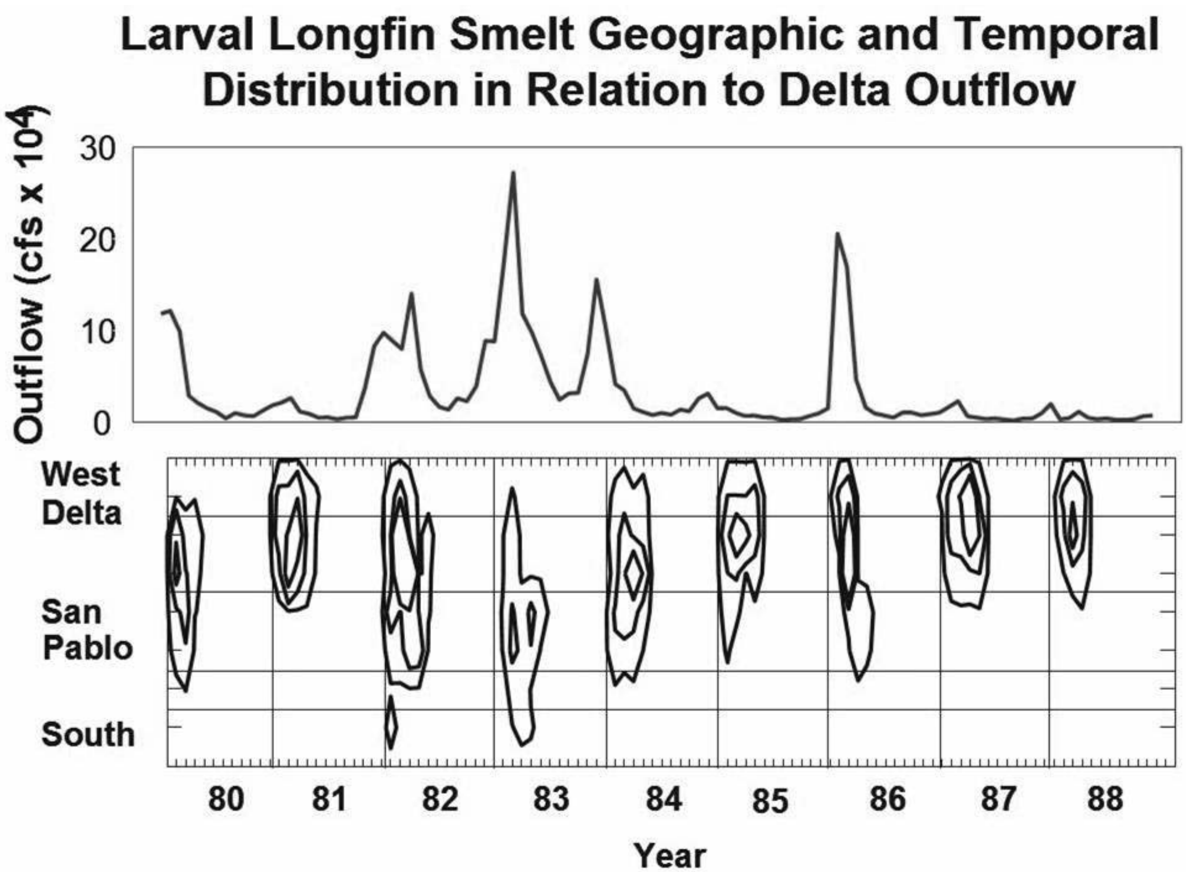


Figure 6-14. Larval Longfin Smelt Distribution Plotted as Average Density by Month and Embayment (1980-1988) (Baxter 2008)

Conclusion. The RPA component 2 actions are intended to reduce OMR influences on entrainment of larval and juvenile delta smelt as well as improve habitat conditions within the Delta. Improvements during the time frame targeted by these actions will also benefit longfin smelt, although the degree of benefit is yet to be determined pending further investigation of the vulnerability of longfin smelt to OMR flows. The effect of the actions on X2 should reduce entrainment of longfin larvae by providing spawning, and thus location of larval emergence, further west. The net effect of decreasing X2 and increasing delta outflow and the E/I Ratio will reduce entrainment and improve larval and juvenile rearing growth and survival. Finally, the conditions attributed to increased entrainment since 2003 will not be possible under the BO and RPA component 2, providing opportunity for a positive response in the longfin smelt population as larval abundance increases.

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